POWER

A McGRAW-HILL PUBLICATION—ESTABLISHED 1884
ELY C. HUTCHINSON, *Editor*

Volume 73 NEW YORK, MAY 5, 1931 *Number 18*

Looking Backward

I SAT in one of those emporia which have evolved from boot black stands to shoe polishing parlors or have become departmental to more inclusive establishments for the reconditioning of head and foot gear.

In addition to the range of elevated armchairs with polished foot rests, before which uniformed attendants with dexterous manipulation of brushes and cloths brightened the understanding of men, there were little inclosures where the customer might sit in stockinged seclusion while one skilled in the surgery of foot gear restored his to service and presentability.

In a corner an expert in head covering steamed and fashioned and ironed and brushed hats of all shapes and colors, reminiscent of the perennial discussion between the old-time salesman and his employer as to whether the daily ironing of the silk hat was an eligible item for the expense account.

Machines clanked and whirred. Steam contributed to the processes. The floor and wall coverings, lighting fixtures, furniture and decorations were modern, well kept and of superior quality.

And my mind went back to the little neighborhood shop where we boys used to love to watch the cobbler wax the bristles into the end of his thread, and ask him questions that he could not answer until he had cleared his mouth of pegs. His stock did not come in cartons of neatly stamped-out parts, but in hides, from which he cut them as wanted and from scraps of which he made suckers for us when time was plenty and we were in favor.

The gloom was pierced by a kerosene lamp with a tin reflector on the back wall, and his work illuminated with another lamp which hung between his knees. He would no more have blacked your shoes or put in a new lacing than a hotel clerk would bring you a plate of soup. He was a master workman.

The modern pedestrial parlor is brighter, cleaner, and more efficient. It does in minutes what it took the cobbler hours to do, and makes a neater and much more comfortable job of it. It is convenient to be able to be reshod and rehatted while one reads a couple of pages of the morning paper.

But I cannot imagine a boy sitting around it for amusement and companionship. And I cannot imagine anybody in it making a sucker for a boy except to order and at a price.

Have you ever seen one of your favorite nooks cut up into a shiny real estate development? As a residential section it is an improvement—but it used to be so nice to steal off into as a nook.

And I caught a sense of the loss that is felt by those who utter "mechanization" with so much of regret.

F. R. Low

EDITORIALS

Preheating With Diphenyl Oxide

FOR SEVERAL YEARS engineers have speculated on the possible uses of diphenyl oxide in power plant practice, and much work of an experimental nature has been carried on. At first it was thought to be suitable in a binary cycle for steam generation, but a better knowledge of its characteristics has led to the abandonment of this idea.

It does, however, offer possibilities as a medium for heat storage and heat transfer, especially as its specific heat is 3.78 times that of water. Concerning the former, it has been suggested as a means of storing heat during off-peak periods to heat feed water during peak-load periods, thereby permitting the turbine bleeders to be closed. For the control of superheat and for reheating steam between high- and low-pressure turbines it has desirable features. These and several other uses are being investigated and announcement of some early applications of this sort may be looked for.

Still another use is in air preheating where it permits independent control of primary and secondary air temperatures and eliminates considerable duct-work. The first installation of this kind to be announced is in the new Bremo Bluff station of the Virginia Public Service Company, which will go in service this month. Reference to that station will be found elsewhere in this number. The performance will be followed closely, and, if predictions are borne out by operating experience, another advance will have been made in power practice.

Hydraulic Laboratory Available To Steam Plant Designers

IT WOULD be interesting, were it possible to find out, to know how many steam engineers are aware that a national hydraulic laboratory is now under construction at the Bureau of Standards in Washington, D. C. It would be even more interesting to knew whether any steam men have considered the possibility of service the laboratory may render them.

At first thought the mention of hydraulics is apt to cause the steam engineers hardly more than the passing interest any recognized engineering specialty is given.

Nevertheless steam plants include among some of their most important auxiliaries, apparatus, such as pumps, condensers, fans and blowers, the efficient use of which will be greatly increased if steam engineers will take a greater interest in the laws of hydraulic flow and also their analogy to the flow of air.

It has been left to a hydraulic engineer to find a way to circulate condensing water in a large steam plant at a velocity approximately five times as fast as ordinarily used in the passages to and from the condenser with no increase of hydraulic loss. And the work was done with models in a hydraulic laboratory. Contrast this with the rule-of-thumb methods still so largely used in proportioning water passages in many otherwise-modern steam power houses. Then think of the obvious neglect of the principles of flow exhibited in the air ducts and pump discharge and suction lines in many of the best and biggest steam stations.

These things need not be. And now that the National Hydraulic Laboratory offers facilities for model and experimental research not hitherto available for such work, it is hoped that steam engineers will use them.

Check Your Power Consumption

WHEN power is purchased, as it is in many large office and other types of buildings, there are many opportunities for saving in its cost. It has frequently been demonstrated that the possibility for saving in the distribution and utilization of power is equal to the cost of its generation.

Elevators are one of the largest consumers of power in buildings. Power demand by such equipment may be doubled as a result of operators making false stops, improper lubrication, worn grooves in sheaves, allowing motor-generators to run when elevators are not in service, and other causes. A comparison of power consumption with stop records of elevators shows that invariably the power per car-mile increases with the number of stops. A poor operator on a hand-controlled car may increase the power consumption one-third.

Elevators are not the only machines in a building wherein power may be wasted. There are plenty of records to show that pumps, compressors, fans and other devices may, without any external evidence, develop conditions which materially increase their power consumption. Frequently an additional power requirement is warning of a pending failure, and when the cause of the increase in power is removed a potential breakdown and a large repair bill are eliminated.

Power consumption and preventive maintenance are closely associated. By keeping a careful check on the power used by each piece of equipment, not only can losses be kept to a minimum, but savings in repairs may be realized.

Surface Condenser Improvements

A FEW YEARS AGO many thought that surface condenser design had reached its ultimate development and that little further improvement was possible; yet recent improvements indicate that further progress may still be made and that better performances can be secured.

In the days when little attention was given to the purity of feed water, leakage of condenser tube packing was not taken seriously. Such leakage is not permissible with make-up for modern boilers of high-pressure or high-steaming capacity. Hence tubes rolled at both ends are becoming popular. This practice has led to various methods of providing for tube expansion, such as bowed tubes, floating heads, expansion joints at the tube sheet, and steel bellows in the condenser shell itself. These have resulted in better condenser construction and operation and in less outage for maintenance.

The provision of steam lanes to distribute the steam among the tubes, of means for draining the condensate, of a supply of steam to heat the condensate passing to the hotwell, and of adequate cooling of the vapors and gases on their way to the air pumps, have all led to more effective use of the cooling surfaces.

In addition to the numerous investigations now being carried on with reference to tube materials, attention has been directed to the heat transfer in the tubes. As a result of some recent studies in England, we may expect further improvements in this aspect of design. Cleanliness of tube surfaces has much to do with the effectiveness of heat transfer, with the degree of vacuum carried and with the outages for cleaning. In some cases the sand-blast action of silt in the water keeps the tubes clean. This may be simulated by the use of powdered-coal ash or similar material. Many plants are employing chemical methods, such as chlorination.

Construction of the condenser shell itself is also undergoing changes. In Europe cast iron has been replaced to a large extent by riveted steel shells, and such construction is beginning to find favor in this country.

Loss of head at the tube entrance is receiving attention, and designs have been evolved to produce a venturi effect. A more careful study of water distribution and water circulation in waterboxes, together with further studies of losses at entrances and exits of tubes, should lead to improvements which may result in decreasing the pumping head and auxiliary power.

Jarred Into Progress

THE CURVE of progress is rarely smooth. History reveals long periods wherein the world merely existed, with changes too slight to be observed from one generation to the next. At other times—as today—this old globe moves with incredible swiftness following some major jolt from science, religion, politics, economics or invention.

The individual has a way of getting into a rut until some inward inspiration, or outward blow, starts him along a new course.

It is the same with companies and with whole industries. Who has not seen the old-established "leading company," deadened with self-satisfaction, finally wakened from its lethargy by a rising tide of competition?

In similar fashion whole industries move ahead by jerks in alternate periods of sleep and of feverish progressiveness. More often than not the awakening force is some new invention that upsets the existing competitive balance until all have adopted it.

"Hitch-hiking" progress continues today in the marine field, although the periods are shorter. Not long ago marine engineers had everything perfected. It remained only to copy one good old engine after another—and to sleep. Then came the turbine with one awakening and the diesel with another. More recently high pressures—and welding.

Today, after this series of jolts, the marine engineering field is as wide awake as that of power engineer's on land. The traditionalists are hiding or being converted, and present marine developments may well inspire even the progressive land-locked brethren.

Example: welded hulls and welded machinery foundations, both demonstrated successes. Another: the welded-drum boiler, now officially accepted by a proverbially conservative naval body.

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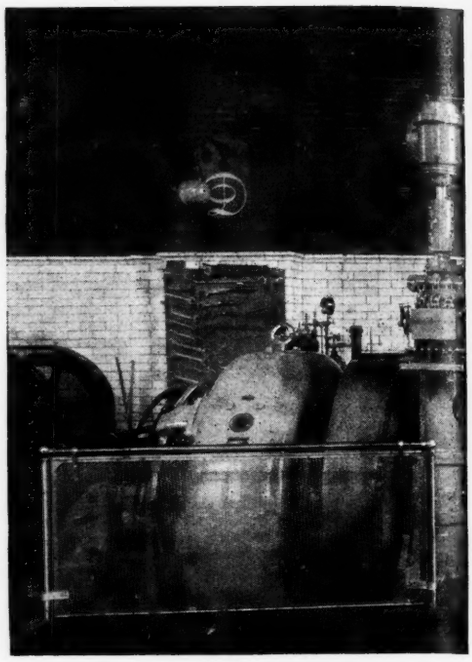
POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

Three Sources Supply Power at Dennison Mfg. Co.



THE Dennison Manufacturing Company, makers of labels, tags and many other paper specialties, has three sources of power in its Framingham, Mass., factory: a steam plant, the public utility and a diesel plant.

Originally, power was obtained from a steam plant, composed of vertical boilers and two 350-kw. and 250-kw. direct current corliss engine-generator units. In winter practically all of the exhaust steam was needed for building heating and process work. In summer much of the exhaust was wasted to the atmosphere, for local conditions prevented condensing operations. The valley about Framingham is underlaid with about 600 ft. of silt, laid down during the last glacial period, and no underground water is available for condensing purposes. With the extension of the factory, the power requirements soon overcame the low-pressure steam needs, with the result that even in winter steam exhausted into the atmosphere.

It was decided to take service from the public utility, and put the alternating current through rotary converters to supply the direct current needed in the factory. The steam plant operated in parallel with the transmission line, and energy was purchased to meet the portion of factory demand above that generated by the steam going to the factory. This was originally purchased on a schedule having an energy charge plus a yearly demand charge based on the average of any twenty daily 30-min. peak demands during any one month. As the winter consumption necessarily was much below the summer needs, the demand charge was a sizable portion of the total power bill.

The average consumption was 600 kw. By 1929 the factory load had increased to where the steam plant alone could not handle it, and the purchase of energy was no longer a mere method of obtaining an economical heat balance, but was a necessity. At once the management was confronted with the question of uninterrupted service. Sudden storms might cause line interference, which would necessitate a partial shutdown of the factory, so that it did not seem advisable to place entire dependence on the outside connection with the public utility.

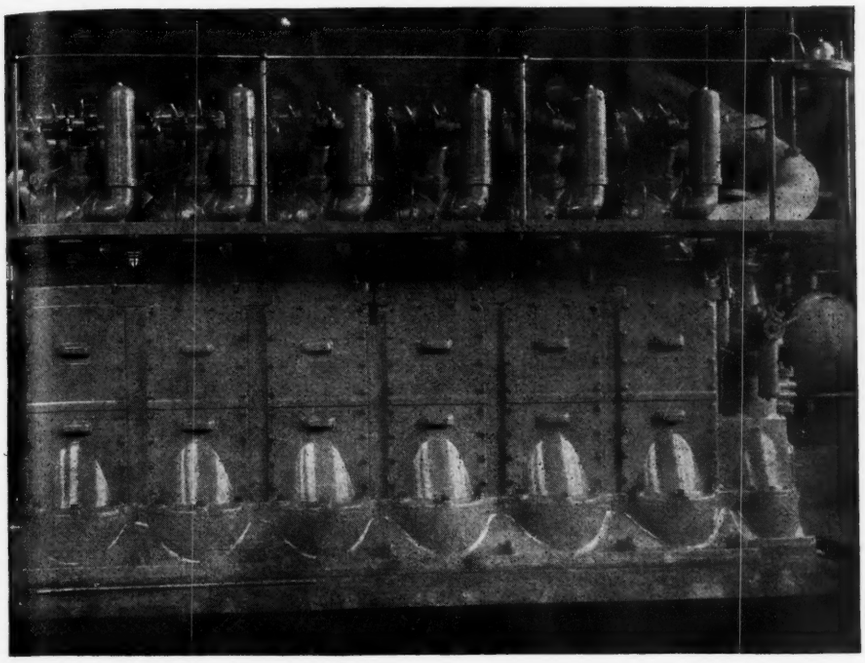
On the other hand, the lack of condensing water made an addition to the steam plant inadvisable, unless the plant were completely rebuilt, with modern high-pressure boilers and bleeder turbines to reduce the existing water rate, which did not seem advisable at that time.

After full consideration of all elements in the problem, decision was made to install a 525-hp. Lombard air-injection diesel. The presence of the diesel enables the purchased-energy peak demands to be held down to approximately the average demand, and as the factory can carry the entire load with the steam plant and the diesel engine, the public utility does not need to have reserve equipment to meet sudden peaks, which permits the application of a schedule giving a lower total energy rate.

At the same time, in case of a breakdown in the steam plant the full factory load can be carried by the diesel and the transmission line. Factory shutdown because of power shortage is eliminated. This, incidentally, is an important factor seldom given its proper consideration in power-supply studies.

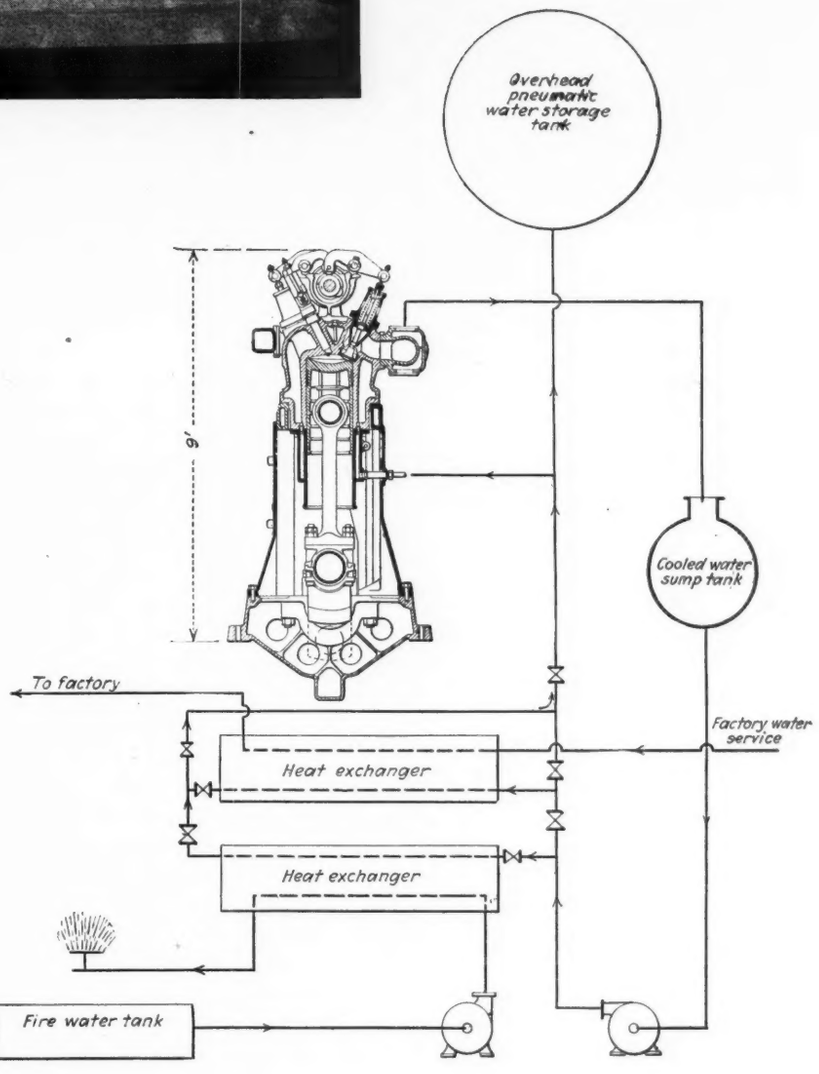
The diesel is installed in one end of the old steam plant, with the foundation carried up from the basement. Space is available for a second unit when the load increase justifies the addition.

While a diesel plant is practically self-contained, with but a small number of exceptions, the Dennison installation has some rather unusual features. A closed system of cooling water is employed, with two heat exchangers, as shown in the illustration. As the mill has a fire protection tank outside the power plant, this water is used to cool the engine water, and is then discharged through four spray nozzle heads into the fire tank. To eliminate, so far as possible, the expense of make-up water made necessary by the evaporation loss at the sprays, the second heat exchanger is cooled by the fresh water going to the mill-supply tank. By proper manipulation of valves the exchangers may be run either in parallel or in series and the cooling divided at will between the two. The circulating-water pumps are in the basement, along-



The 525-hp. diesel-generator unit, added to give a better heat balance, is installed in one end of the old engine room

Diagrammatical layout of the cooling-water system, in which the jacket water is cooled by the factory service water and by water from the factory fire-protection tank



side the engine foundation, while the steel sump tank into which the jacket water discharges is on the engine room floor.

The jacket water, after passing through the heat exchangers, is pumped into a header connecting to an overhead air-pressure tank. By the arrangement of valves, this pump can be used to force water to the engine jacket by a straight pressure system, leaving this overhead tank as a reserve in case the pump should shut down. A continuous bypass withdraws part of the lubricating oil for treatment in a centrifuge. As the engine employs air-injection to atomize the fuel, a cheap grade of oil may be burned. At present Bunker A fuel is handled with success, without any treatment other than passing it through screen filters.

The engine is somewhat individualistic, departing in many respects from the more or less standardized design. Cylinder heads and cylinders are cast as units, without removable liners. These castings rest on the top of the crankcase and are provided with removable skirts to form the lower ends of the cylinder bore. To inspect a piston the skirt is unbolted and by the use of a special crane fixture the piston and skirt are tilted so that they may be removed through the crankcase-door opening. In spite of the tradition that removable liners are necessary, records indicate that at least five years' use is obtainable from one of these cylinder castings before wear makes renewal necessary. Comparison of the cost of purchasing and installing a liner with the cost and replacement labor of a new cylinder casting reveals that the new cylinder is the cheaper plan, an unexpected situation in replacement.

While the diesel has not been operating long enough to permit its unit generating cost to be calculated with certainty, present data indicate that the cost will not exceed 1.16c. per kilowatt-hour. The regular steam plant force handles the diesel with the same ease and confidence as it operates the steam equipment.

Preventing Noise Transmission In Buildings

By R. C. ALLEN

General Engineer
Westinghouse Electric & Mfg. Co.

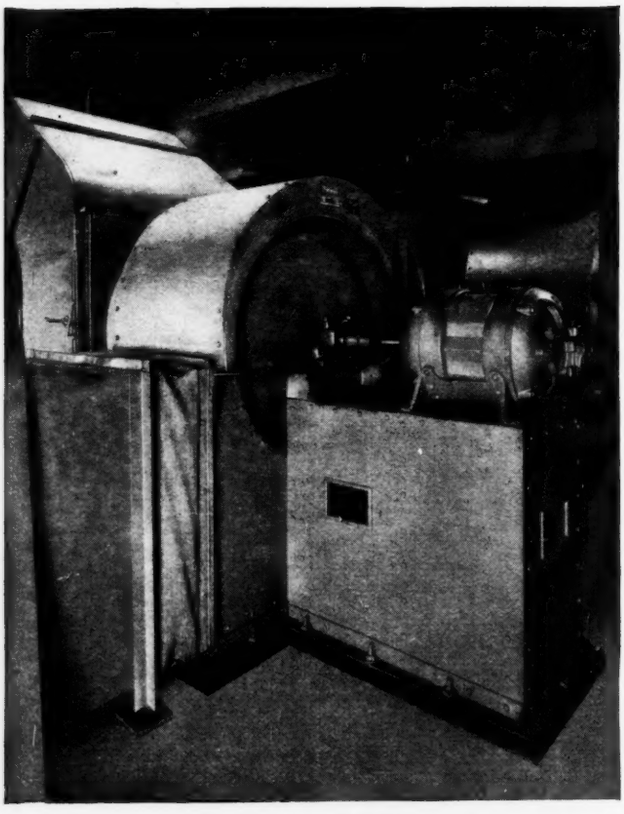


Fig. 1—Blower and motor on a quiet foundation, with the blower connected to air duct by canvas section

Preventing the transmission of machinery noises in buildings is one of the most difficult problems with which the building engineer has to contend. A method devised for analyzing the nature of noise and several expedients for preventing its transmission through foundations to buildings are described here.

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ARCHITECTS, engineers, and owners of modern office buildings particularly, are demanding that the apparatus in the building be noiseless or at least so installed as not to be heard by the tenants. The demands for quietness are growing more and more exacting. A machine that would have been classed as satisfactory a few years ago would not be considered so today.

Perhaps it is more because, in the large modern building, motor drives are, of necessity, found throughout the building and frequently on mezzanine floors adjacent to important office space. In the older buildings machinery was installed in the basement or in the penthouse well away from rentable space. The modern building structure, with its relatively thin reinforced concrete floors and walls, makes an excellent transmitter and amplifier for any noise that may be generated.

Any moving machinery makes a noise. Motors especially can make the type of noise that is easily transmitted through a building structure if it is not properly isolated. Building engineers and architects, appreciating this problem, are specifying heavier and more stable floors for motor rooms. Motor and machinery manufacturers are designing apparatus that is more quiet than formerly and the contractor is installing, usually according to the architect's specifications, sound-absorbing foundations for the equipment. All of these tend to make more satisfactory installations; but an installation that would be rated as satisfactory by one individual would not be so classed by another, particularly if the latter, for some personal reason, wished to take a disagreeable attitude. Some even use a stethoscope for detecting noise.

Unfortunately, there is no standard of noise, or quietness, so the motor manufacturer usually is made to assume the blame even though the unit would have been satisfactory if properly installed. Noise is a relative term and comparisons are generally made by reference to another unit that is considered quiet. This is not always satisfactory, because the quiet motor is not always available for comparison and a person's recollection is very defective in comparing sounds.

There is, however, an instrument, called a sound analyzer, Fig. 6, that accurately measures noise, so that a motor or other unit can be given a noise number that will mean the same tomorrow as today. The instrument

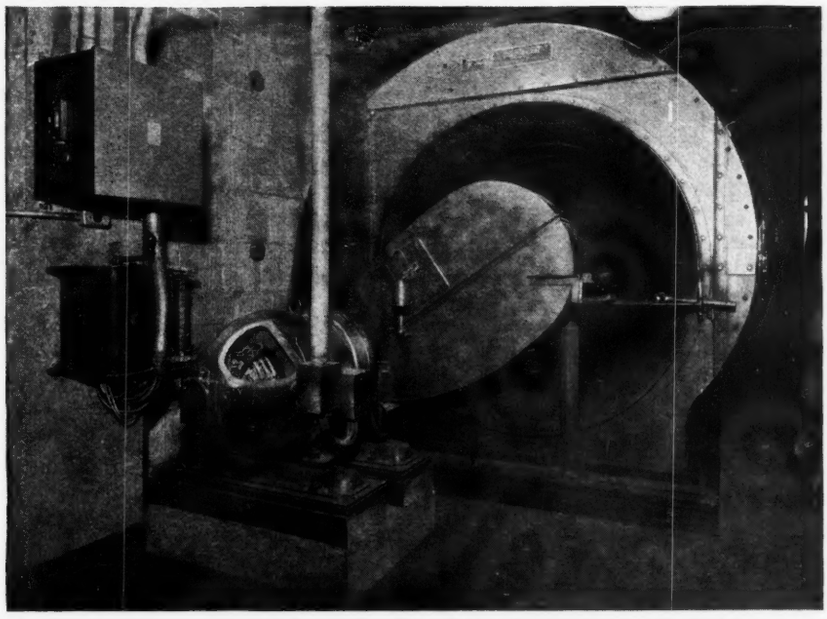

Fig. 2—Motor and blower on separate foundations of wood and cork, the cork being directly under the machines

consists of a microphone, tubes, condensers, and resistances composing an electrical circuit that can be tuned to the frequency of the different sound components that go to make up the noise, and by means of an indicating meter, measure the strength of the sound vibration. This is a definite and accurate test and should be used as a basis for purchasing, testing and approving installations where quiet units are necessary. Such a standard would help in determining whether the fault, in a particular installation, lay with the motor, the driven unit, the foundation construction or is caused by the building's design.

In general, there is but little trouble experienced with motor installations where the problem is understood and proper precautions taken. Although the motor and blower designer attempts to secure units that are quiet, there is, as stated previously, always some noise or vibration inherent in practically every piece of moving apparatus that might be considered noise under certain conditions. It is essential, therefore, that precautions be taken to prevent any noise generated from being transmitted through the building.

Noises generated are of two classes: (1) those that are transmitted principally through the foundations, such as a motors' magnetic hum, and (2) those transmitted through the air, such as motor brush noise or the blade noise of a fan. The latter, air noise, can be damped by inclosing the unit, for instance, building a room around it. The larger the room the less the noise that will reach the outside. If this is not sufficient the walls can be doubled to create an air space, or lined with a sound-absorbing material. The door should not be forgotten and if necessary a double door should be used. The motor itself can be inclosed or boxed in to advantage sometimes, but ample ventilating air must be supplied or the motor will run hot and may injure its insulation.

If the room is small, open windows or louvered openings will often reduce the noise, as the sound pressure waves then have a relief rather than vibrating on the wall. The vane noise of a blower is sometimes resonant with the air duct and requires a change in the duct shape or a necking down of the duct for a short distance to break up the wave.

Magnetic or similar vibrations require a sound-absorbing foundation. These are of many types, but they all incorporate a resilient or non-resonant substance in the foundation that will tend to absorb, or at least not transmit, the vibrations. Such substances are cork, felt, springs, and the like, and even cinders and sand for certain types of installations. There are also many commercial or patented materials or foundations for noise elimination. Practically all of these include a mounting for the unit separated from the floor foundation by non-resonant material. It is essential, of course, that the bolts holding down a unit do not pass into the building floor, as any unit vibration or noise will pass along these bolts almost as readily as if the unit were mounted directly on the floor.

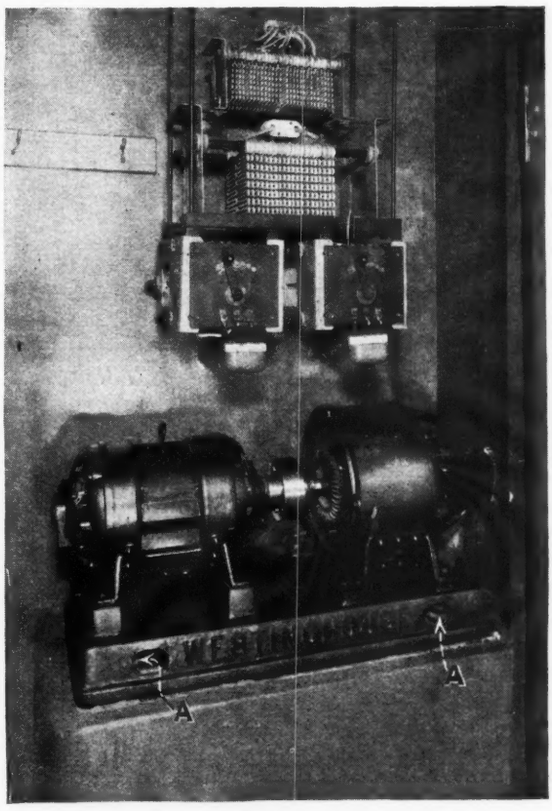

Fig. 3—Motor-generator set mounted on spring A

It is something of a problem to secure a unit to such a foundation to prevent side movement resulting from belt pull of a motor's drive. With blowers and direct-drive motors mounted on the blower pedestal, the foundation can be of cork and wood extending around the unit's edge. The cork is inserted between the base and the blower frame, Fig. 4, the holding-down bolts passing into the wood but not through it. A second set of bolts fastens the base to the floor. The cork must, of course, be securely fastened.

For heavy units like motor-generator sets the cork can be retained by channel bars having the cork between the flanges. But steel has to be used with discretion, as it trans-

mits vibrations readily and may defeat the noise insulation.

It is preferable, with high-pitched noises, to mount the unit on a heavy concrete slab about half the weight of the unit and to support the concrete on cork pads at least at each corner, Fig. 7. The cork should be hard-pressed and large enough in area to limit the unit pressure to a value that will not give the cork a permanent set. As a further precaution the pads can be made up of alternate layers of cork and tile, preferably ½ in. thick, or of felt. In such a foundation the concrete, due to its mass, absorbs much of the vibration, and the pads, being resilient, transmit but little of what remains. Pads in layers of different material further break up the vibration. With belt drives and the like lateral movement is prevented by a coping of concrete or wood separated from the block by cork or felt.

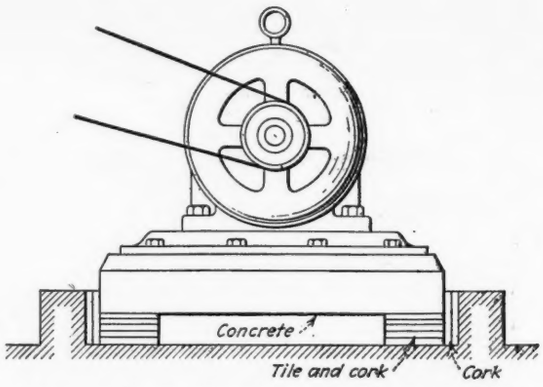

Fig. 7—Concrete foundation insulated by cork and tile for belted units

Springs Used in Machine Mountings

One of the most effective types of foundation, though not the least expensive, makes use of springs as the resilient member, Fig. 3. These are used particularly for motor-generator sets or where no side thrust is encountered. With the magnitude and period of the noise components known, correct springs can be calculated that will prevent practically all of the noise vibration from being transmitted. It is sometimes necessary to employ dashpots to prevent excessive rebounding. It is essential, for accurate and best results, to calculate also the period of vibration of the floor to keep away from any dangerous resonance of the floor structure.

Felt alone is used extensively as the resilient member, Fig. 5, though this has a tendency to mat and lose its resilience unless it is of a specially designed type. Felt is used where the pressure per square inch can be lower than for cork.

Heavy machinery, or even light units, if on a rigid base or concrete slab, can rest on a bed of sand. The sand should be retained by a casing or box and covered with a layer of tar or asphalt to hold it in place and exclude the moisture and dirt.

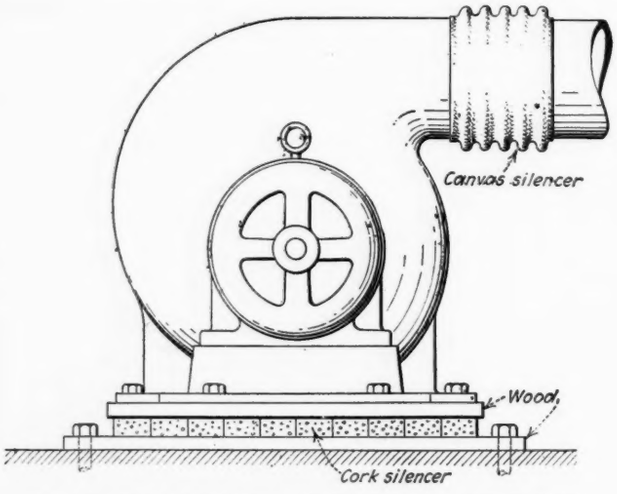

Fig. 4—Cork-and-board sandwich for a machine's base

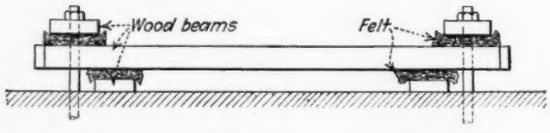

Fig. 5 — Beam-type sound-absorbing mounting for motors and blowers using felt between beams

Insulating Ducts and Pumps

With units such as blowers and pumps the ducts and pipes must also be insulated, or at least separated from the building structure, to prevent noise transmission from this source. Blower ducts should be separated from the blower by a canvass section, Figs. 1 and 4, and piping should rest in an insulated saddle.

Foundations with felt usually consist of boards or planks built up as a crib and separated by the felt. This is a very effective foundation, particularly if the noise is not very severe and no side thrust is encountered.

For belted units a saddle has been devised consisting of a felt in a U-shaped retainer that holds the supporting beam while being attached to the floor foundation or to another beam, Fig. 8. Being a commercial product, the desired shape and size can usually be secured for a quick

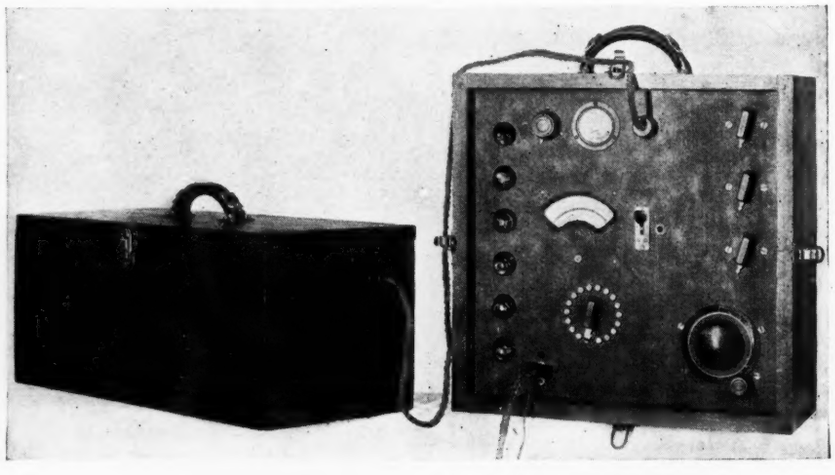

Fig. 6—A sound analyzer that accurately measures noise so that motors and other machines can be given a noise number that will always have the same meaning.

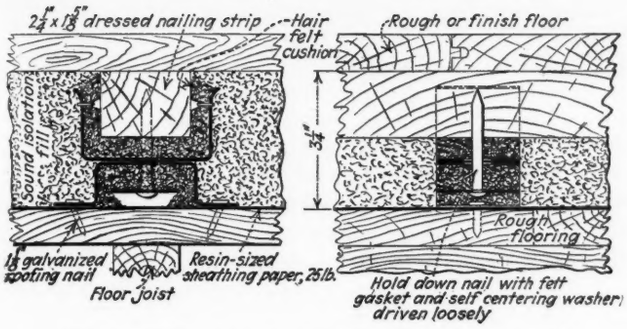
2¼" x 1⅜" dressed nailing strip
Hair felt cushion
Rough or finish floor
Sound isolation fill
3¼"
Rough flooring
1⅛ galvanized roofing nail
Resin-sized sheathing paper, 25 lb.
Floor joist
Hold down nail with felt gasket and self centering washer driven loosely

Fig. 8—Felt placed in wood foundation to prevent noise transmission

change, if desired, to reduce the noise nuisance in an installation.

Sometimes when the soil under a foundation is soft or in layers the vibration of a reciprocating machine is transmitted quite a distance. This is not a noise vibration, because it is of too low a frequency, and has to be treated differently. Usually such a vibration has to be corrected by changing the counterweights on the unit to change the direction of the vibration.

The cause and elimination of noise vibration in motors and other machinery is a difficult, yet interesting, subject, but is not pertinent to this subject of foundations. It is difficult to give general rules for determining the type, size and arrangement and the best foundation, but published data are available on the commercial types. In general, the unit must be entirely separated from the building by a high-grade sound-absorbing material which is not loaded beyond its normal resilience.

It must be remembered that considerable responsibility rests with the machinery manufacturer to produce as quiet units as possible, with the architect to provide adequate building supports, with the contractor to install the unit properly for a satisfactory installation, and, last but not least, with the inspector not to expect perfection when there is no standard, but his own, of perfection.

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Efficient Operation of Existing Ice Plants

By M. F. KNOY

TO SECURE the maximum efficiency an ice plant must, of course, be correctly designed, but it must also be skillfully operated. Even where the design is not of the best, skillful operation may go a long way toward keeping down production costs. In fact, a logical conclusion is that the most poorly designed plant should be the one to show the greatest response to correct operating practice, and this is frequently the case.

One of the obvious ways of keeping down power consumption, and one that is applicable in every ice plant, is the full utilization of tank area. The only way to use tank area is to keep each can in the process of freezing ice at all times, or, in other words, each block of ice must be harvested as soon as frozen so that a new can of water can begin the process. Any time that a considerable portion of the cans in a freezing tank is frozen solid ahead of the ice puller, the owner is realizing no benefit, for the time being, from just that number of cans.

It, for example, during the slack season the plant operator keeps the tank at 20 deg. F. and yet has half of the cans frozen solid, he could harvest the same amount of ice by raising the tank temperature by $\frac{32-20}{2}$ deg., enabling him to operate with a tank temperature of 26 deg. instead of 20 deg. This temperature increase would enable him to realize considerable power economy.

Every engineer is familiar with the rule that, other things being equal, the power consumed by the ammonia compressor per ton of refrigeration decreases as the suction pressure is increased. Likewise, a study of the ammonia tables, as well as experience, indicates that the suction pressure increases as the tank temperature is raised. This rate of decrease in the power consumption is shown graphically in Fig. 1, assuming a condensing temperature of 75 deg. in each case. For other condensing temperatures the rate of change would be slightly different, but would still be very marked for all ordinary conditions.

In the example, then, let it be assumed that the condensing temperature remains at 75 deg. while the evaporator temperature is increased from 15 to 21 deg. At the higher suction pressure the mean effective pressure will actually decrease slightly although the weight of ammonia being handled per stroke has increased considerably. Hence the power consumed per ton of refrig-

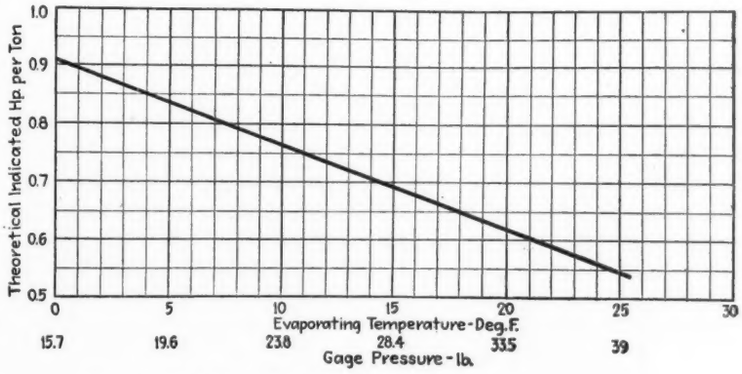

Fig. 1—Variation of theoretical compressor horsepower with suction temperature

eration will be reduced. The reduction amounts in this case to aproximately 13 per cent of the compressor power, as shown in Fig. 1.

Another saving would be realized on the power consumed by the condensing water pump and other compressor auxiliaries, since the compressor would operate fewer hours per day, due to the greater amount of refrigeration performed per stroke. At 15 deg. the saturated ammonia vapor has a density of 0.1524 lb. per cubic foot., while at 21 deg. the density is 0.1728 lb. per cubic foot. It is thus seen that the compressor will handle about 13.4 per cent more gas per stroke at the higher temperature. The net refrigerating effect per pound of ammonia will also be greater at the higher temperature by about 0.4 per cent, thus making the refrigeration performed per stroke 13.8 per cent greater. It is thus evident that for the same ice production the compressor will operate 13.8 per cent fewer hours per day, and the power consumed by its auxiliaries will be reduced by that amount.

Another saving, though a minor one, resulting from increased tank temperature would be the reduction in refrigeration losses from the entire low-temperature portion of the system. The magnitude of such losses depends, of course, upon the difference in temperature between the cold surfaces and their surroundings. Any reduction in this temperature difference will cause a corresponding decrease in the losses.

Not only during the slack season, but at all times, an ice tank should be operated at the highest temperature that will produce the required amount of ice. The practice of some engineers of freezing up a large portion of the tank ahead of the pullers, for the sake of having the ice in reserve, is of questionable economy. This cannot be done without suffering an increased power consumption. It is probable that any ice-storage capacity that may be required will be cheaper in the form of a regular ice-storage vault than in the ice-tank area.

Taken singly, some of the improvements suggested in this article may seem trivial, but in combination and worked out to the fullest extent they have been the means of effecting worth-while economies in more than one ice plant

The chief ill effects of superheated suction gas are increased power consumption, reduced compressor capacity and excessive discharge temperatures. Just how these factors may affect plant economy may be seen from a concrete illustration.

Effect of Superheat in the Suction Gas

Assume a suction pressure of 15 lb. gage and a temperature of 32 deg., which corresponds to approximately 32 deg. of superheat. Also assume a discharge pressure of 165 lb. gage. From the Mollier chart we find that the heat content of the suction gas will be 630 B.t.u. per pound, that of the discharge gas 753 B.t.u. per pound, and the heat of compression will be 753 — 630 = 123 B.t.u. per pound. Heat of the warm liquid will be 143 B.t.u., and the net refrigerating effect per pound of ammonia handled will be 630 — 143 = 487 B.t.u. This is 3.96 times as great as the heat of compression. If the compressor were operating on dry saturated gas we find from the chart, in the same manner, that the heat of compression would be 114 B.t.u. and the net refrigerating effect 469 B.t.u., which is 4.114 times as great as the heat of compression. Note that this ratio is approximately 3.9 per cent as great as the corresponding ratio found for the superheated suction gas. This means that when operating with the superheat assumed above, the power consumed per ton of refrigeration will be 3.9 per cent higher than if the suction gas were saturated.

As to the effect of this amount of superheat on compressor capacity, a glance at the relative density of the saturated and the superheated gas reveals that the superheat has reduced the compressor capacity by about 7 per cent. The exact reduction of compressor capacity will, of course, be different for different amounts of superheat. Fig. 2 shows graphically the effect of superheat on both compressor capacity and power consumption, based upon the assumed pressures.

Again using the Mollier chart, we find that the discharge temperature for the superheated suction gas would be approximately 278 deg, while for the saturated suction gas it would be only about 233 deg. At the higher discharge temperature the ammonia and the lubricating oil would tend to decompose much more readily, thus forming non-condensible gases. These gases, collecting in the high-pressure portion of the system, cause a rise in the head pressure, which, in turn, causes a still further rise in the discharge temperature. This again still further hastens decomposition, thus setting up a vicious circle. A compressor working under these conditions will require more maintenance, and more oil, ammonia and power.

Causes of Superheated Suction Gas

The most common causes of superheated suction gas are insufficient feed to the main evaporator, long uncovered suction lines and the use of dry suction gas for cooling can water in forecoolers.

In case the liquid feed to the evaporator is insufficient it is easily remedied by opening up the expansion valve. The most satisfactory operation of evaporators is secured by equipping them with automatic float-controlled expansion valves. This, however, is impossible in many of the older plants, and the operator must depend upon the skillful adjustment of the manual expansion valve.

Care must be taken to see that feeding is not overdone, as too much liquid in the suction will likewise increase power consumption and reduce compressor capacity. The presence of liquid ammonia in the suction gas is denoted by a discharge temperature that is distinctly below that indicated by the Mollier chart for the working pressures in question. If the excess is great enough the compressor cylinders may be frosted over. While the frosting over of an uncovered suction line is not necessarily an indication of wet suction gas, the frosting over of the cylinders is almost a sure indication. One certain check is the comparison of the discharge temperature with the theoretical as determined from the Mollier chart.

The long, uncovered suction line is perhaps the most frequent offender in the matter of suction superheat. In such cases the compressor is not only handicapped as to capacity and efficiency, but it also has an increased burden of refrigeration to perform due to the heat absorbed from the air by the suction line. There is, then, a double waste.

Forecooling can water by means of the dry suction

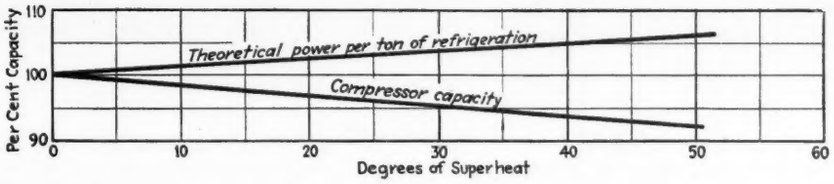

Fig. 8—Influence of superheat on horsepower and capacity

gas is a practice that is on the decline, and rightly so. Not only does this practice entail all the penalties of superheated suction gas, but it greatly increases the difficulty of properly regulating the expansion valve. Particularly is this true where the ice is pulled more or less in batches. Filling a great many cans in rapid succession causes the forecooler to fill completely with warm water, resulting in undue superheating of the suction gas. Cases of this kind have been observed in which the gas reached the compressor as warm as 50 or 60 deg. F.

Eliminating Wet Compression

If the operator attempts to correct this condition by increasing the ammonia feed, the forecooler will become too cold as soon as he quits filling cans and then the plant will suffer the ill effects of wet compression. By the time he has remedied this condition he will likely be ready to begin filling cans and start the cycle all over again. The one sure way to end such troubles for all time is to bypass the suction line entirely around the forecooler coil. If refrigeration must be provided for the forecooler is should come from the evaporation of liquid ammonia supplied by a separate expansion valve, rather than by superheating the suction gas.

Some question might arise as to whether it is desirable to forecool the can water at all. Its only advantage when done at the regular suction pressure is the slight reduction in the freezing time it makes possible. I have made a careful check to see just how great this reduction in freezing time might be. I found that 72 deg. water when placed in an 18 deg. tank is reduced to the freezing point in about thirty minutes. This, then, is all that the warm water would delay freezing at that tank temperature. Since the total freezing time under these conditions is approximately fifty-four hours for the ordinary 300-lb. can, it will be seen that thirty minutes more or less does not mean a great deal. It is probable that any beneficial results of this small reduction in the freezing time is more than offset by the refrigeration losses from the forecooler and from the can filler tanks. Possibly the use of a separate machine operating at a high suction pressure for this purpose would show sufficient power economy to justify the installation of the equipment, but that would not be true in every case.

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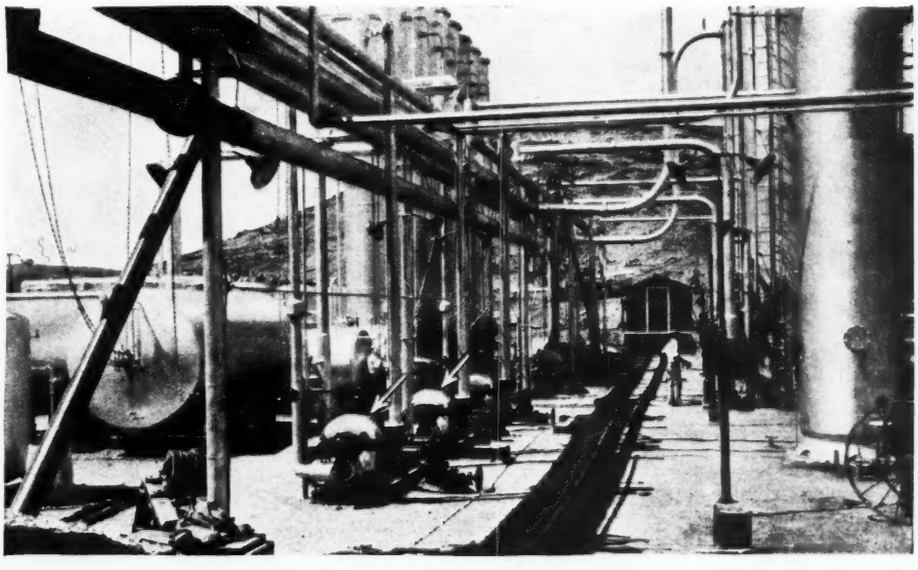
Steam Turbines Run on Natural Gas



Petroleum World and Oil Age

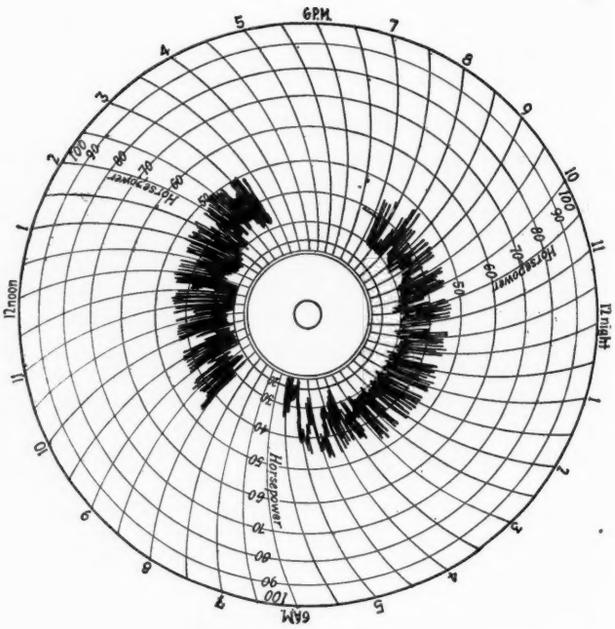
AT THE Los Nietos Producing & Refining Company's plant in Kettleman Hills, Calif., steam turbines driving centrifugal pumps are being operated directly on natural gas. Two of these units are indicated by the arrows in the accompanying illustration. The turbines are Terry Type Z2, rated at 50 hp., 2,100 r.p.m., and operate normally on steam at 145 lb. pressure and 125 deg. F. superheat. They are direct connected to two Byron Jackson Type S5 centrifugal pumps operating in parallel, each with a capacity of 955 g.p.m. against a total head of 81 ft. Natural gas is supplied to the turbines at about 180 lb. pressure and 266 deg. F. temperature, and exhaustive tests have shown that performance is the same as with steam. When there is a surplus of steam over that required for refining processes, the turbines are run on steam; otherwise natural gas is used.

Cutting Steam Costs 24 Per Cent in a Small Plant

By K. D. KNOBLOCK

Engineering Department
Federal Public Service Corp.

In the Burlington plant of the Wisconsin Southern Gas Company, a reduction in steam generating cost of 24 per cent has been realized by the substitution of pulverized coal for hand firing and new boilers, principally through a reduction in labor costs, greater over-all efficiency, decreased coal cost, lower maintenance and a more uniform steam production.



Typical steam flow chart

IN THE majority of small water-gas works the boiler plant is neglected. Great care is taken to watch the efficiency of the gas-producing equipment; oil and gas-producing coal are weighed and measured and expenses are carefully checked; but one of the main production expense leaks is usually neglected or overlooked. Although the steam required in the gas-making process and for the driving gas plant and boiler auxiliaries makes up approximately 20 per cent of the total cost of manufacturing carburetted water gas, many small gas companies take the boiler plant for granted and assume that it is producing steam as economically as can be expected.

High efficiency with high evaporative rates is not possible in small water-gas plants, principally because of the nature of the load. Without going too far into the process of manufacturing water gas, it can be described briefly as the breaking down of water into its constituent elements, hydrogen and oxygen, by passing steam through incandescent carbon. These elements then combine with carbon to form the gas. After this is done for periods of three minutes, it is necessary to raise the temperature of the incandescent carbon by blowing air through it for periods of three or four minutes. The period in which steam is passed through the coal is known as the "run," while the period during which air is blown through is called the "blow."

In the Burlington plant live steam at boiler pressure is used in the gas-making process. Thus for periods of three minutes a peak load is put on the boilers, and for the succeeding "blow" the load drops off about 50 per cent. This can be clearly seen from the typical flow meter chart here reproduced. At present the nominal steam demand varies between 7,500 and 10,500 lb. per hour, while for the "run" periods it increases to 15,000 lb. or more. To improve the load factor and to provide a steady load to help counteract the effect of the gas-making process, a corliss engine-driven generator is operated to furnish electricity for the entire plant. The total load consists of a number of steam-driven auxiliaries, including boiler-feed pumps, water pumps, gas compressors, and turbine-blowers, in addition to the steam required in the gas-making process.

To get the proper background one has to go back to 1927, when the Citizens' Gas Company property was acquired by the Federal Public Service Corporation. The company was reorganized and the name changed to Wisconsin Southern Gas Company. In May, 1927, the maxi-

mum gas send-out was 100,000 cu.ft. per day, and the company served only 900 customers, all in the town of Burlington. The boiler plant consisted of one 800- and one 1,000-sq.ft. horizontal return-tubular boilers, hand-fired, with shaking grates. As was the practice when the plant was built, some twenty or thirty years ago, the boiler room was situated in an out-of-the-way corner and was in a deplorably rundown condition.

By May of 1929 the company was serving over 2,200 gas customers in ten towns, and the send-out had increased to 200,000 cu.ft. The maximum steam load, estimated to exceed 6,000 lb. per hour, was being carried by two 1,500-sq.ft. horizontal return-tubular boilers which had replaced the original boilers. It became apparent that this boiler plant would be unable to handle future load increases and, as a matter of fact, was not even capable of carrying economically the maximum load at that time. Maintenance became excessive; it was necessary to employ an extra fireman; and at times both boilers were operated to provide sufficient steam.

Therefore, it was decided to construct an entirely new and independent boiler plant, the chief considerations being capacity, efficiency and flexibility. The plant was designed to care for 400,000 cu.ft. per day gas production immediately and 800,000 cu.ft. by 1933. The size of the boilers was based on this estimated gas production. Two 3,000-sq.ft. cross-drum Lasker water-tube boilers with air-cooled settings were installed, it being planned to operate one boiler to handle the entire load and hold the other boiler as a stand-by.

Each boiler is served by a Strong-Scott underfeed pulverizer capable of delivering 1,500 lb. of coal per hour. Coal is fed by gravity to the pulverizers. The coal-handling equipment consists of a concrete-and-steel track hopper, screw loading conveyor, bucket elevator and drag flight conveyor, all motor-driven and operated by push-button controls from the boiler room floor. The coal is fed by gravity to the mills. Draft is provided by a concrete stack 6 ft. 6 in. in diameter x 178 ft. high. A rectangular breeching of 24-sq.ft. cross-section enters the stack at a point 15 ft. above the base. As the gases pass from the breeching to the stack there is a slowing down in velocity, owing to an increase in cross-sectional area of 9 sq.ft. This, in combination with the change in direction of flow, causes a large portion of the fly-ash to settle in the base of the stack.

The boilers are set relatively low. Setting walls 18 in. thick are made up of 10 in. of common brick on the outside, and 8 in. of plastic firebrick lining. The latter is cooled by means of a number of small metal air ducts extending the full length of the setting. Air is drawn in at the center of the back wall and passes to the front through the air ducts in the side walls, into a sheet metal header. It is preheated to 300 deg. F. Some additional air is taken in at the pulverizer through a manually controlled damper valve.

A full year's record of plant operation is not available at this time, but a comparison has been made of corresponding six-month periods before and after installing the new plant. As most of the gas plant records are based on gas produced, rather than steam produced, a comparison is presented on that basis.

While the total gas production during these periods increased from 39,000,000 cu.ft. to 48,000,000 cu.ft., the total steam production cost decreased from $6,108 to $5,735. The principal reasons for the reduction in operating costs are, less coal per 1,000 cu.ft. of gas, lower plant labor expense, and decreased maintenance.

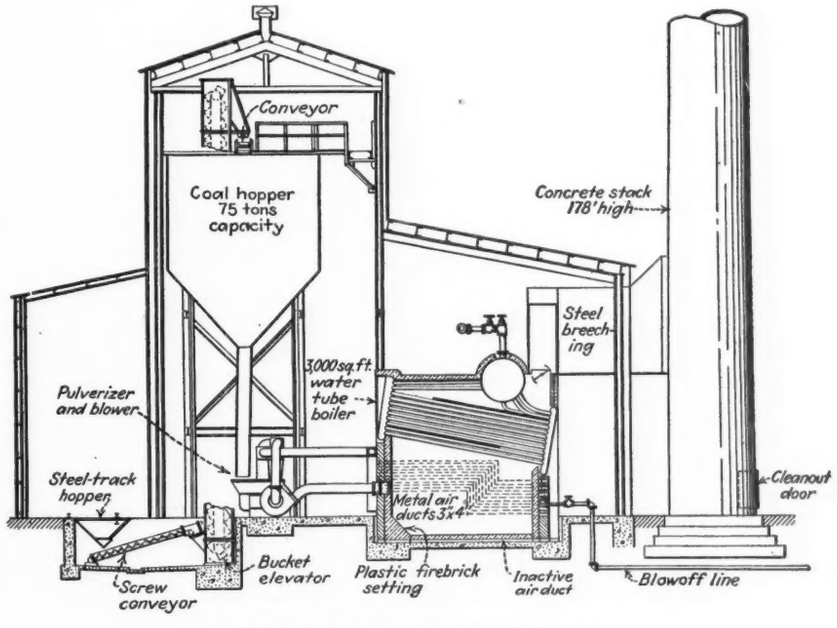
SUMMARY OF PLANT OPERATION

	Six-Month Period Ending Sept. 1929 (Old Plant)	1930 (New Plant)
Gas made, cu.ft.	39,215,000	48,436,000
Steam coal used, tons	1070.8	1176.8
Tons of coal per 1,000 cu.ft. of gas	0.0273	0.0243
Ave. cost of coal per ton del.	$4.05	$4.02
Total cost of coal	$4,326.74	$4,730.74
Boiler plant labor	$1,320.00	$780.00
Maintenance	462.00	$225.00
Total steam production expense	$6,108.74	$5,735.74
Ave. cost of steam per 1,000 cu.ft. of gas	$0.1557	$0.1184
Net saving per 1,000 cu.ft. gas, steam production only	.....	$0.0373

From the table it can be seen that the cost of steam production decreased from 15.57c. per 1,000 cu.ft. of gas made to 11.84c., which is a decrease of nearly 24 per cent.

Besides the saving in steam cost, the new plant has resulted in other indirect savings. For instance, it has been possible to reduce electric power bills substantially, as most of the electric requirements are now handled by the plant. It was possible to eliminate part-time labor in the gas-manufacturing department, as the fireman has some time free to devote to maintenance of gas apparatus and tools, all of which was formerly handled by extra labor. Finally, operation of steam equipment is smoother because of better pressure regulation and an ample supply of dry steam.

The company hopes to further reduce production cost by using a cheaper grade of boiler fuel, by using exhaust steam in the gas-making process and by motorizing many of the steam-driven auxiliaries. These changes, together with an ever-increasing gas production, should be the means of realizing new levels of operating economy.



Sectional elevation through boiler house

Controlled-Stroke Pumps for Solid-Injection Diesels

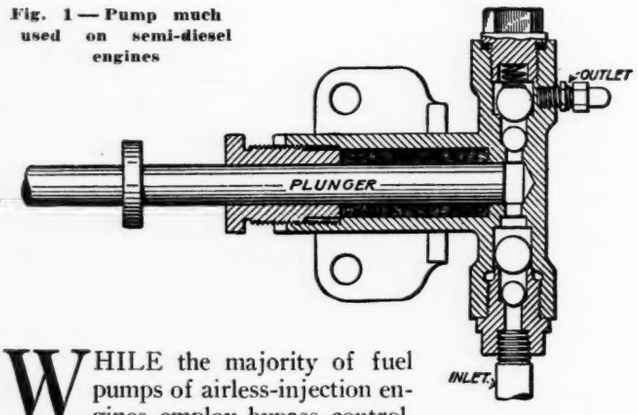


Fig. 1 — Pump much used on semi-diesel engines

WHILE the majority of fuel pumps of airless-injection engines employ bypass control, discussed in *Power* of March 24, there are a number of engine designs in which is incorporated some form of a pump with a variable stroke. These variable-stroke pumps may be one of two types, to give a constant fuel discharge velocity or a variable velocity.

The advantage of a constant velocity for the oil forced to the spray nozzle is obvious. If the orifice is the correct one to enable the spray to penetrate the cylinder air charge and at the same time to atomize the oil satisfactorily, a variation in the pressure at the orifice may upset the chosen conditions. While an oil spray rapidly assumes a conically diffused form, there is a contraction of the oil stream slightly ahead of the orifice exit, exactly as with any other nozzle stream. If the velocity is increased, as would be the case on heavy load with a variable pump discharge velocity, this contraction will be closer to the orifice. As the spray begins to diffuse instantly upon leaving the orifice, the flame approaches the orifice tip, and a carbon deposit, of crater shape, results. This finally fouls the tip, and a smoky exhaust makes its appearance.

On the other hand, on light loads the injection velocity may be so low that the fuel is improperly atomized, which leads to inferior combustion and high fuel consumption.

But when applied to engines having precombustion chambers or on low-pressure semi-diesels, a variation in the rate of fuel discharge is not serious, for at best the spray is not expected to be finely divided, and the inflow of air from the cylinder gives enough turbulence to mix the air and oil thoroughly.

Furthermore, some pumps that appear to give a variable fuel velocity have a fairly consistent rate of flow. For example, the rather elementary fuel pump shown in Fig. 1 is driven by an eccentric so arranged in reference to the out position of the pump plunger that only a part of the throw is used to move the plunger. Consequently the velocity is not excessively variable, although toward the end of the injection stroke the velocity falls sharply, which leads to dribbling, a no-serious matter in low-compression engines.

As far as commercial engines go, variable velocity is employed only with "open" nozzles, that is, nozzles with no closure other than a check

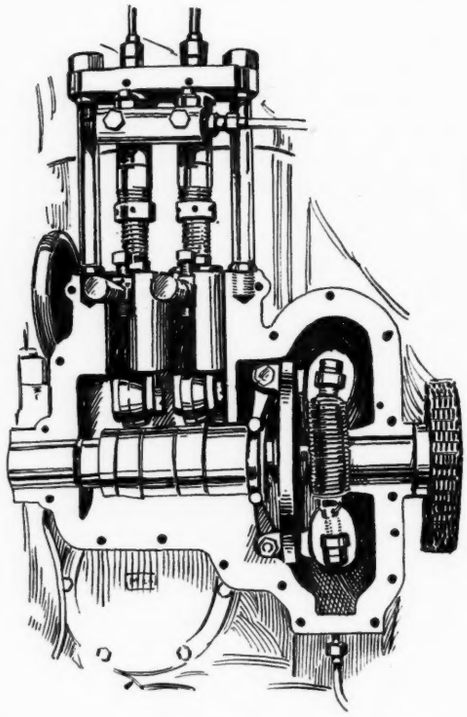


Fig. 4—The skew-cam pump of a precombustion engine

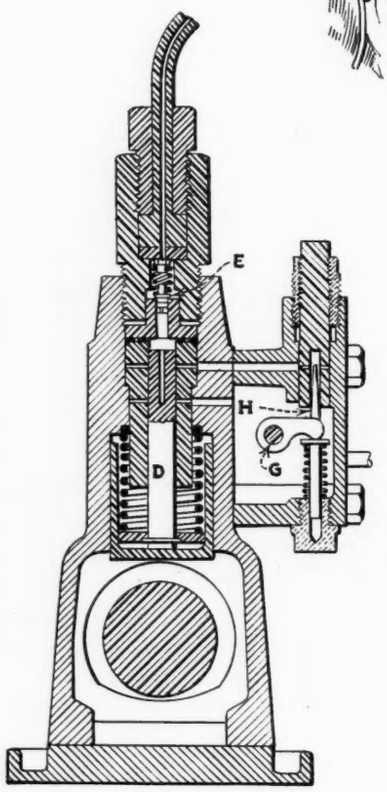


Fig. 2—This pump has a throttled suction

valve to prevent the back flow of combustion gases. If a spring-loaded spray valve were used, the valve would not open until the line pressure exceeded the spring tension, and at a variable oil velocity the needle, or valve stem, would chatter as the oil pressure built up to the spring load and dropped away as soon as the valve opened to permit egress.

The chief advantage of the variable-velocity pump is that the entire pump and driving mechanism may be simple in design and inexpensive in replacement. Usually, however, the speed regulation is not so good, for the governor in most cases must shift a mechanism that receives the pump plunger load.

As has been observed, Fig. 1 gives a variable velocity, especially a variation in the rate of flow during a single injection period, although the variation between the flows at two engine loads is not marked. It is impossible, of course, with any pump in which the plunger is cam-operated to have a uniform rate of discharge during the whole injection period, for the plunger must be accelerated from zero velocity and negatively accelerated at the end of the stroke.

Fig. 5 shows a type of pump not so generally found on modern as on older engines. The cam revolves at a constant rate and has a constant rise. The movement of the plunger is in proportion to the cam rise, the ratio at any load being determined by the position of the wedge block, which is under governor control through suitable linkages.

A pump that gives similar discharge velocity characteristics is shown in Fig. 6. Here the plunger is driven by a connecting rod whose lower end is in contact with the gradient of the roller arm. The cam has a constant rise, or lift, and the length of plunger stroke depends upon the position of the connecting rod in reference to the quadrant; the closer the governor swings the rod toward the lever bracket fulcrum pin, the shorter is the pump's stroke. Obviously the crank angle through which the pump delivers the fuel is constant regardless of the pump stroke. Consequently the oil velocity varies widely with changes in engine load.

An unusual pump appears in Fig. 2. This is a throttling type. The pump plunger makes the same stroke regardless of load, but the effective stroke during which oil is discharged depends upon the amount of oil admitted by the suction control valve, which is under governor control. During the suction stroke of the pump, oil enters through the control valve and partly fills the pump cavity. On the discharge stroke the oil flows back into the suction chamber until the suction port is covered, whereupon the plunger raises the oil charge up against the discharge valve, which then opens, and oil is forced through the discharge valve into the fuel line. This pump gives a more or less constant discharge velocity, as the plunger's delivery stroke is that part of the pump cavity occupied by the oil charge.

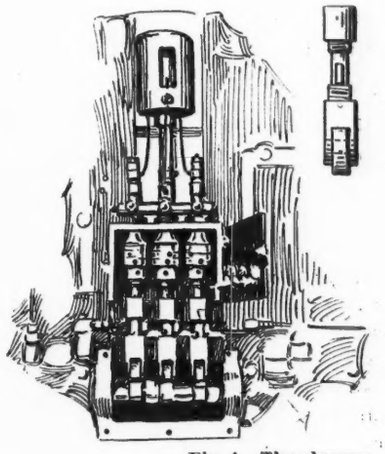


Fig. 4—The plunger stroke is varied by a bolt

A method of fuel measuring more common a few years ago than now is the use of a skew cam, which is shifted lengthwise under the pump plunger roller to obtain the proper plunger lift for the engine load, Fig. 3. It is possible to design the cam to give the pump identical velocities at any point in the pump stroke regardless of the total plunger stroke, by a suitable design of the cam. This, however, is not usual practice, and the delivery velocity varies throughout the stroke, which causes the fuel spray to be coarse at the start and end of injection.

Still another variable-stroke pump is shown in Fig. 4. This is a modification of the pump of Fig. 3. The plunger always comes to rest at the end of its spring-actuated suction stroke at a fixed point. The push rod between the cam and the plunger is made up of two blocks and a right-and-left threaded bolt. The bolt is provided with a slot and key which is connected to the governor shift rod. At a change in the governor position the bolt is turned so that it draws the two blocks together, thus increasing or decreasing the clearance between the push rod and the plunger. This, of course, alters the plunger's discharge stroke. If the cam is properly made, the pump will have constant delivery characteristics at all loads.

While it must be conceded that bypass-controlled pumps are more evident on modern engines, the plunger-controlled pump has its place. If an engine has either a precombustion cavity or has an excellent air distribution the plunger type is satisfactory. Experiments indicate that a spray need not be so extremely fine. If the spray is directed to strike the piston crown the rebound of the resulting fine spray will diffuse the oil through the air.

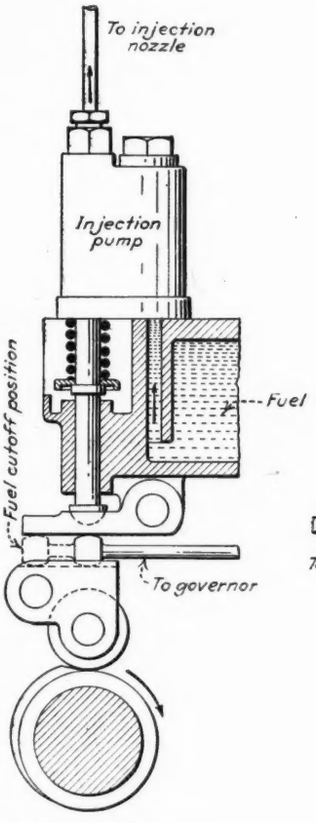


Fig. 5—A wedge-type fuel pump

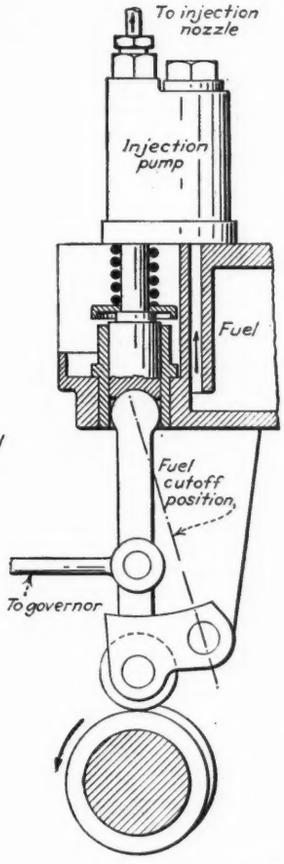


Fig. 6—A pump having a variable stroke

Hydraulic-Type VARIABLE-SPEED TRANSMISSIONS

The different types of mechanical variable-speed transmissions were described in articles appearing in the March 10 and 24 numbers. This story gives a description of three designs of hydraulic variable-speed transmissions

By F. A. ANNETT
Associate Editor, POWER

VARIABLE-SPEED transmissions may be divided into two general classes: mechanical and hydraulic. The latter, the type to be considered in this article, consist, essentially, of a variable-displacement pump that delivers oil to a constant-displacement motor. By varying the pump's stroke, the amount of fluid delivered to the motor varies, and, consequently, its speed. This type of drive can give a speed range to the output shaft from zero up to the full speed of the input shaft and in either direction.

Fig. 2 shows the parts of a Waterbury hydraulic variable-speed transmission. In this design the pump and motor are combined into a single unit, as in Fig. 1. Where it is desired, the pump and motor may be operated as two separate units connected by a delivery and a return pipe. The pump and motor ends of the unit are practically the same, except that the position of the cylinder connecting-rod socket plate on the pump can be adjusted to vary its stroke.

Beginning at the left-hand end of the picture, Fig. 2, is the tilting box T, in which the socket ring R is revolved. The angle the tilting box makes with the vertical can be adjusted by the control C. In the face of the tilting ring is a roller thrust bearing against which the socket ring operates. The socket ring is provided with seven or more bronze sockets to receive the piston connecting rods. The pistons can be seen at E and are connected to the socket ring by rods having spherical ends. Each piston is ground to a good fit in a ground cylinder bore in the cylinder barrel B. By properly fitting the pistons it has been found that the leakage can be kept small without using packing rings.

When not under pressure, cylinder barrel B is held against the valveplate V by a spiral spring, between the back of the barrel and a collar on the shaft. In operation, the cylinder barrel is held against the valveplate by the pressure due to the difference in the areas of the ports in the valveplate and the cylinder barrel. In the valveplate there are two semi-circular ports P that pass through the plate and connect the pump with the motor. The ports in the motor cylinder barrel B' can be seen in its left-hand end. Similar ports are in the pump's cylinder barrel B. As the cylinder barrel rotates, its ports pass in succession over the valveplate ports. While the cylinders pass by the valveplate ports, one port acts as intake and the other as the discharge for the cylinders. Two relief valves are provided in the valveplate. In the relief valve are ball check valves through which oil flows to maintain the pressure system full.

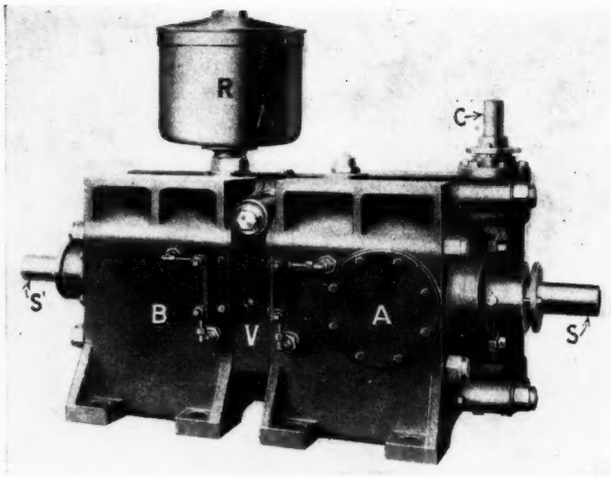


FIG. 1—PUMP AND MOTOR OF A WATERBURY HYDRAULIC VARIABLE-SPEED TRANSMISSION
A is variable-displacement pump, *C* the pump's control, *V* the valve plate, *B* the constant-displacement motor, and *R* the fluid-storage reservoir.

The motor's socket ring R' is similar to that for the pump. The angle box A performs a similar function to that of the tilting box T, but is not adjustable and is set to carry the socket ring at an angle of 20 deg. from the vertical. The roller thrust bearing D, on which the socket ring runs, can be seen inside the angle box.

A cross-section of the pump and motor is shown in Fig. 3. In this cross-section the control and pump are on the right, whereas in Fig. 2 they are on the left. The rotating element of the pump and of the motor are each carried in a bronze sleeve bearing in the casing and a roller bearing in the valveplate. A universal joint U connects the socket ring to the shaft and allows free movement of the ring as the shaft rotates. Each cylinder barrel is keyed to its shaft, but the keys do not transmit the working torque.

In Fig. 3 the tilting plate and socket ring of the pump are shown in the neutral position, that is, they are perpendicular to the shaft. If the input shaft is turned the socket ring R and the cylinder barrel B will turn with it and there will be no motion of the pistons in the cylinders of either the pump or motor. If the control C is turned so as to tilt the socket ring to a position such as XX the top pistons will be pulled out and the bottom pistons pushed into their cylinders, as indicated by the position of the motor's socket ring R'.

With the socket plate tilted as indicated by line XX, when the socket ring and cylinder barrel are revolved one-half revolution the pistons that were on the bottom at the beginning of the half revolution will be on top and those that were on top will be on the bottom. In this change of rotational position the pistons that were on top and pulled out of the cylinders are pushed in and the ones that were on the bottom are pulled out. That is, by rotating the socket plate when in a tilted position the pistons are made to move back and forth in the cylinders.

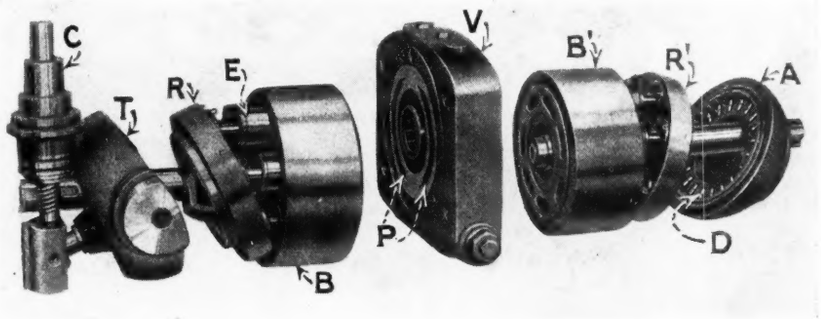
Assume, looking at the input end of the unit, that the input shaft turns in a clockwise direction. As the cylinder barrel and socket ring turn, the pistons and cylinders will be rotating upward on the left and downward on the right. In this operation the pistons on the left will move out of the cylinders and draw oil into them from the valveplate. On the right, the pistons will move into the cylinders and force oil out through the port in the valveplate and into the cylinders of the motor. When a piston is at the top or bottom dead center it is over the space between the two ports in the valveplate. While a piston is moving over this space it changes from suction to discharge. The amount of motion of the pistons, and, consequently, the oil pumped, depends upon the angle at which the socket plate is tipped.

By tilting the socket plate toward the top of the valveplate the action of the pump is reserved. For example, if the socket plate is tilted to position YY the top pistons will be pushed farther into the cylinders and the bottom ones will be pulled farther out of their cylinders. If the socket ring and cylinder barrel are revolved in a clockwise direction, the pistons on the left-hand side will be pushed into the cylinders and those on the right will be pulled out. That is, the cylinders on the right will take in oil from the system and the pistons in the cylinders on the left will force oil out into the valveplate and motor cylinders. This is the reverse operation of that explained for the socket ring tilted to some such position as XX, and would cause the motor to reverse its direction of rotation.

The motor is the same as the pump except, as previously explained, its socket plate is not adjustable but is permanently tilted at an angle of 20 deg. from the vertical. Because of this angle the pistons travel through their full stroke as they move from the bottom to the top and down again. When the socket plate of the pump is tipped at the same angle as that of the motor, the pistons of both have the same stroke and their rotative speeds are practically the same.

From the foregoing it is evident that this transmission provides a means of obtaining speed changes, in infinite steps, from zero up to the speed of the driving power, and in either direction. The accuracy of the slow-speed control is affected by the variation in loads and the temperature and the viscosity of the oil. If accuracy at slow speed is required over a wide range of load the minimum output speed should be limited to 1 per cent of the maximum speed required. That is, if the maximum output speed required is 500 r.p.m. the minimum speed should be limited to 5 r.p.m. The control may be either manual, remote or automatic. These units are built in size for from 8 to 160 hp. continuous duty and for speed ranges of 0 to 900 r.p.m. to 0 to 250 r.p.m., respectively. For intermittent service the horsepower ratings may be increased 25 per cent, and for momentary overloads the working torque can be increased 150 per cent.

The Hele-Shaw hydraulic variable-speed transmission always uses a separate pump and fluid motor. In the pump, a number of radial cylinders with their pistons are rotated about a central cylindrical valve. The cylindrical valve forms a fixed center about which the cylinder body rotates. The position of the piston assembly is adjustable, so that the center about which it rotates can be changed relative to that of the cylinder body. The volume of fluid pumped is controlled by shifting the piston assembly relative to the cylinder body. When the two rotate about the same center there is no pumping



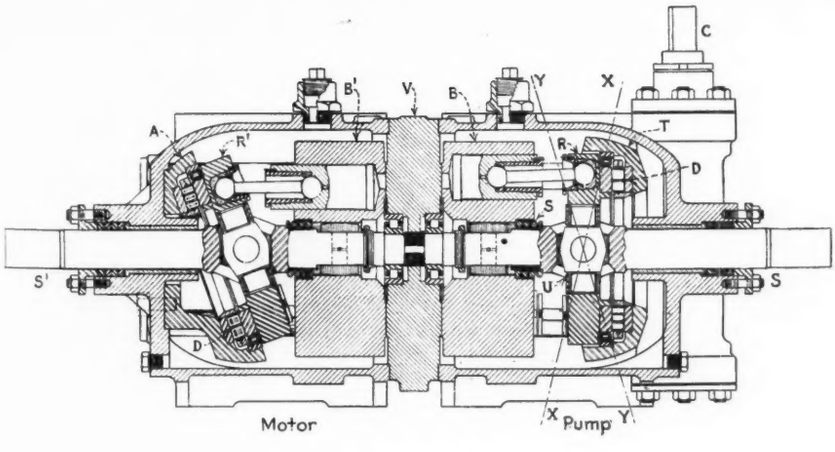


Fig. 2 (Upper Left)—Parts for a transmission similar to that shown in Fig. 1

Fig. 3 (Lower Left)—Vertical section through a transmission similar to that in Fig. 1

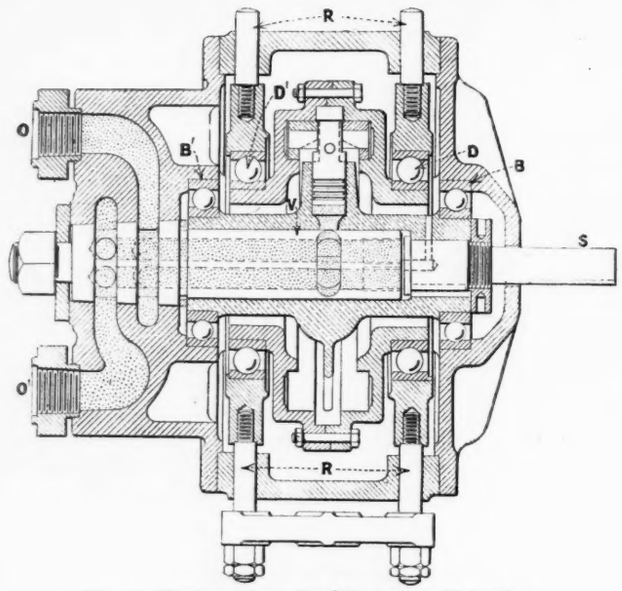


Fig. 4—Horizontal section through a Hele-Shaw variable-displacement pump

action. By increasing the distance between their centers of rotation the volume of fluid pumped is increased. The motor is the same as the pump except that the piston assembly is fixed off center a maximum distance relative to the cylinder body.

Fig. 4 shows a horizontal cross-section of one of the pumps. The central cylindrical valve *V* has four holes parallel to its axis. Two of these holes connect with an intake and a discharge port near each end of the valve, as do the other two. This valve is rigidly supported in one of the pumps's covers and its ports connect to the discharge and intake of the pump. Either opening *O* or *O'* may be discharge or intake, depending upon the position of the piston's center of rotation relative to that of the cylinder body.

Fig. 5 is an assembly of the cylinder body and its pistons with their slippers *S*. This assembly is inclosed in the floating ring *F*, Fig. 6. At each end of this floating ring is the end cover for the pump. On these can be seen two guides *G* between which the floating ring is supported, and can be moved horizontally by a control that is connected to *C*.

The cylinder body is supported in the bearings *B* and *B'* in the pump end covers, Fig. 4, and is there held in a fixed position relative to the central cylindrical valve. The pistons are supported in the inclosing case which is carried in bearings *D* and *D'* and can be moved horizontally on the guides or rods *R* and *R'*. In this way the piston's center of rotation is displaced from that of the cylinder body, which has a fixed position about the axis of the input shaft *S*. When shaft *S* is turned, the cylindrical body, the pistons and inclosing case turn with it and cause the pump to function.

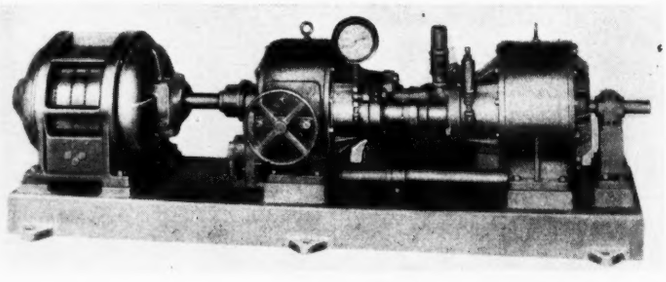
How the pump operates will be made clear by a study of Figs. 8 to 10. In Fig. 8 the pistons *P* and the cylinder body *B* are central about the cylindrical valve *V*. With the cylinder body and the pistons in this position, rotating them about the valve does not cause any discharge from the pump. If the floating ring in which the pistons are carried is moved off center with the cylinder body and the valve, as in Fig. 9, the pump will discharge when rotated.

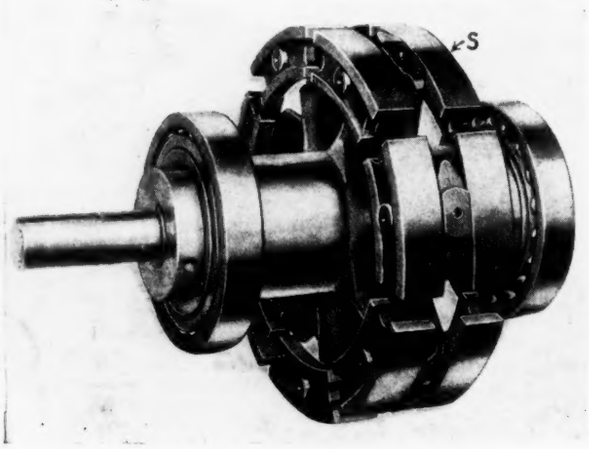
Assume the rotation to be clockwise, as indicated by the arrow, then pistons above the horizontal diameter move into the cylinders and the fluid will be discharged through the two top ports in the valve. Below the horizontal diameter the pistons will be moving out of the cylinders and fluid will flow into the pump. Moving the floating ring with its pistons so that its center is on the side of the center of the central valve opposite to that in Fig. 9, will reverse the operation of the pump. This is shown in Fig. 10. Assume that the pump is rotated in a clockwise direction as it was in Fig. 9. The pistons above the horizontal diameter will move

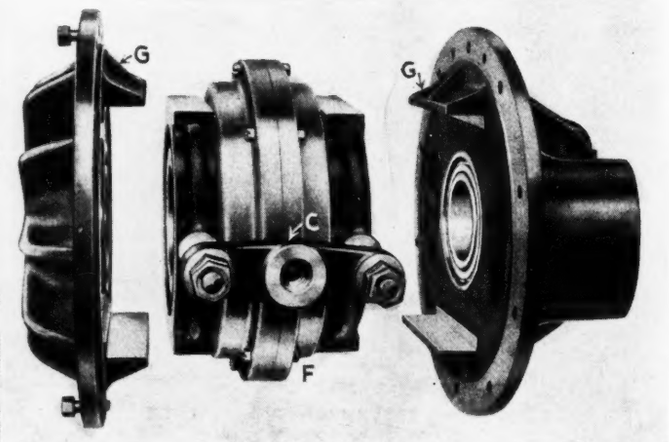
Fig. 5 (Below)—Assembly of cylinder body and pistons for the pump Fig. 4

Fig. 6 (Below Right)—Floating ring and end covers for variable-displacement pump

Fig. 7 (Left)—Hele-Shaw (American Fluid Motors) hydraulic variable-speed transmission. On the left is the motor, in the center is the variable deplacement pump which is controlled by the hand wheel, and on the right is the hydraulic motor







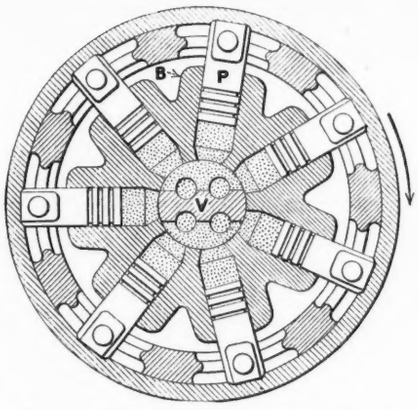


Fig. 8—Diagram of the pump, Fig. 4, in the neutral position

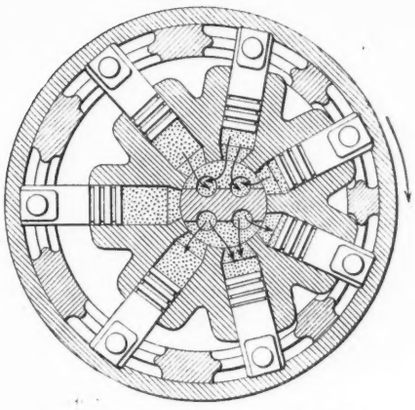


Fig. 9—Same as Fig. 8, with piston assembly moved to the left

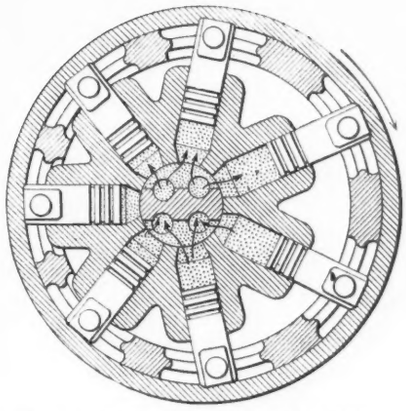


Fig. 10—Same as Fig. 8, with piston assembly moved to the right

away from the central valve and draw fluid into the cylinders. Below the horizontal centerline the pistons will move toward the central valve and force liquid out of the cylinders through the ports.

The action of the motor is similar to the pump. Assume Fig. 9 to be a motor to which the pump is supplying fluid under pressure to the cylinders below the horizontal centerline and fluid is being drawn from the top cylinders. The pistons under pressure will cause the piston and cylinder assembly to rotate about the central valve in a clockwise direction. Putting the cylinders above the centerline under pressure and those below on discharge will reverse the motor's direction of rotation. Therefore to reverse the motor it is only necessary to shift the pump's floating ring assembly, from one side of the centerline of the valve to the other, to reverse the fluid's flow in the system.

The length of the pump's stroke, and, consequently, the volume of discharge, is determined by the distance the floating ring is eccentric with respect to the cylinder body. The volume of this discharge can be controlled in infinite variations from zero to a maximum, which, in turn, produces a corresponding speed in the motor. The maximum speed of the motor is practically equal to that of the pump.

Standard equipment is built in sizes from about ½ hp. at 1,150 r.p.m. to equipment requiring a 110-hp. driving motor at 580 r.p.m. Fig. 7 shows a transmission and its driving motor mounted on the same bedplate. On the left is the motor, the center unit is the pump with its control, and the fluid motor is on the right.

In the pump of the Oilgear hydraulic variable-speed transmission the piston assembly rotates about a fixed center, the center of rotation of the cylinders being adjusted to vary the pump's discharge. The construction of the pump will be made clear by considering Figs. 11 and 12. *B* is the cylinder barrel with four of its pistons in place. The fifth piston, with its reaction plates, is shown at *P*. The cylinder and piston assembly is mounted in the revolving driver *D*. In the center of the cylinder barrel is placed a closely fitted, hardened and ground ported pintle *C* that is the valve for the pump and is fitted into a swinging arm *A*. In this pintle there are four parallel ports, two for discharge and two for suction. Either group of two ports may be discharge and the other two suction, depending on the position of the cylinder barrel relative to the pistons, as will be shown later.

The pump assembly is shown in Fig. 12, with the cylinder barrel *B* and its pistons in the driver *D*. One end of the swinging arm *A* is supported at *E* and the other carries the pintle *C* in the center of the cylinder barrel. The input power is attached to the shaft of driver *D*, which when revolved carries the pistons and cylinders around with it. By swinging arm *A* the position of the cylinder barrel relative to the pistons is changed and the discharge of the pump varied.

When the swinging arm is in the central position, both the driver and the cylinder barrel revolve about the same center and there is no motion of the pistons in the cylinders. By moving the swinging arm to one side of neutral the cylinder barrel is caused to rotate about a center that does not coincide with that of the driver and there is motion of the pistons in the cylinders. As the cylinder barrel is moved to the right or the left the length of the piston stroke is changed, resulting in a flow of oil from the pump in direct ratio to the length of the stroke. This mechanism also gives a reversal of flow, oil passing through the pump in

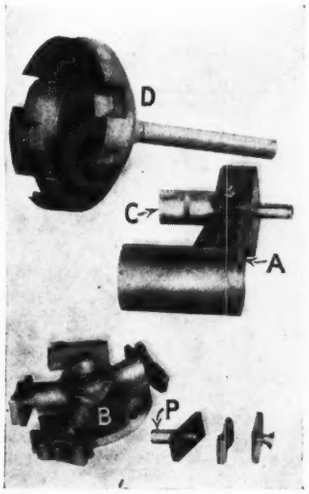


Fig. 11 (Right)—Parts of an Oilgear variable-delivery pump

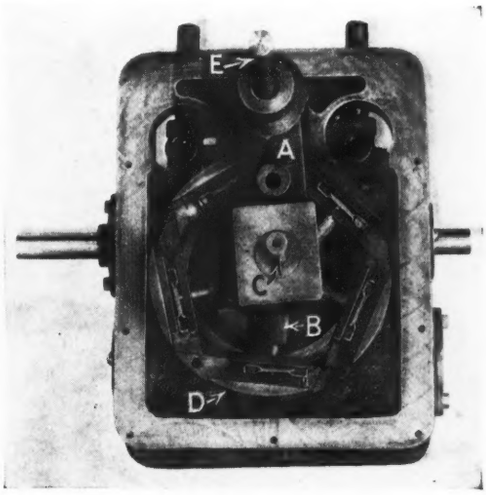


Fig. 12 (Extreme Right)—Assembly of the parts, Fig. 11, in the pump's casing

one direction when the swinging arm is moved to the right and in the other direction when the arm is moved to the left.

Figs. 14 to 16 show the operation of the pump. The pistons are supported in the driver by reaction plates with two hardened-steel rollers that allow free movement of the piston along the crossheads in the driver. In Fig. 14 the cylinder barrel center of rotation coincides with that of the driver, consequently the pistons do not move in the cylinders when the pump is rotated. Fig. 15 shows the cylinder barrel shifted so that its center is to the right of the driver's center. Under this condition, as the pump rotates in the direction of the arrow, the pistons above the horizontal centerline move

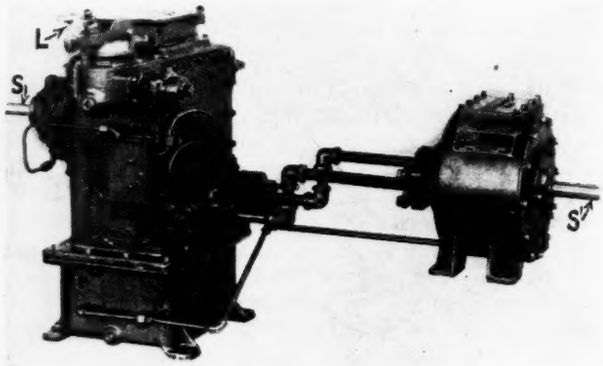


FIG. 13—VARIABLE-DELIVERY OILGEAR PUMP CONNECTED TO A CONSTANT-DISPLACEMENT MOTOR FOR A VARIABLE-SPEED TRANSMISSION

The pump is on the left and is controlled by handle *L*; *S* is the constant-speed input shaft of the pump and *S'* the variable-speed output shaft of the motor.

out of their cylinders and therefore allow oil to flow into the pump. Below the centerline the pistons move into the cylinders and discharge oil. If the cylinder barrel is shifted so that its center is on the left of that of the driver, as in Fig. 15, the oil flow through the pump will be reversed. In the figure the cylinders below the horizontal centerline are under suction pressure and those above the centerline are under discharge pressure.

In the actual pump there is a small low-pressure gear pump that delivers the oil under pressure to the variable-delivery pump, so that the suction of this pump is always under pressure. When the pump is used to operate presses, on the pressure slow-motion stroke, high-pressure oil is supplied by the variable-delivery pump only. To obtain fast motion on the return stroke the two pumps are put in parallel to deliver a large volume of oil at low pressure.

The motors used with these pumps are made in both constant-displacement and variable-displacement types. The variable-displacement motor is essentially the same as a variable-displacement pump from which some of the auxiliary equipment has been omitted. The constant-displacement motor includes the driver, pistons, clyinder barrel and pintle, Fig. 12, arranged so that the center of the cylinder barrel is displaced a fixed amount from the center of the driver, as in Figs. 15 and 16.

In this type of transmission the pump and motor are built as separate units. Fig. 13 shows a variable-speed fluid power transmission; the variable-delivery pump is on the left and the constant-displacement motor on the right. *S* is the input shaft of the pump and *S'* the output shaft of the motor. Control of the volume and direction of the pump's discharge is by handle *L*. With this handle placed as shown the pump is in neutral position and there is no discharge. By moving the control handle to either side of neutral the pump is made to function and the amount of discharge increases as the control is moved off neutral until a maximum is reached. With the control handle on one side of neutral the pump's discharge is in one direction, and when on the other side of neutral the discharge is reversed. As the amount and direction of the pump's discharge change so does the speed of the motor.

Instead of a single unit transmission, as in Fig. 13, where sectional drives are required, one pump may supply several motors, some of which may be constant-displacement units and others variable-displacement types. The speed of the whole machine is adjusted by controlling the discharge of the pump. On those sections that might need slight changes in speed from the base speed, variable-displacement motors are used so that the speed of these sections may be changed from that established by the pump's discharge. The pumps are used for a wide variety of purposes, other than as part of power-transmission units, where oil is required under high pressure for operating presses and other devices.

For assistance in the preparation of this article the author wishes to thank the Waterbury Tool Company, Waterbury, Conn.; the American Fluid Motors Company, Philadelphia, Pa.; and The Oilgear Company, Milwaukee, Wis.

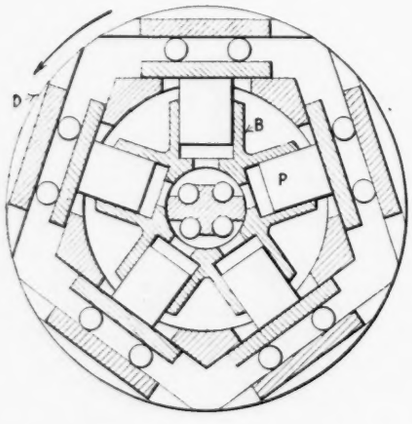


Fig. 14—Diagram of the pump, Fig. 12, in the neutral position

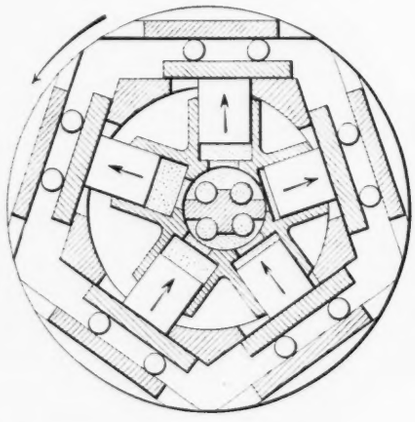


Fig. 15—Same as Fig. 14, with the cylinder barrel moved to the right

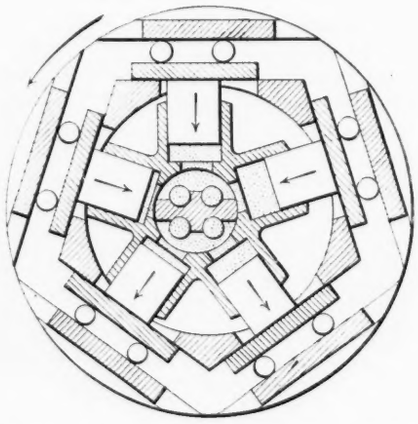
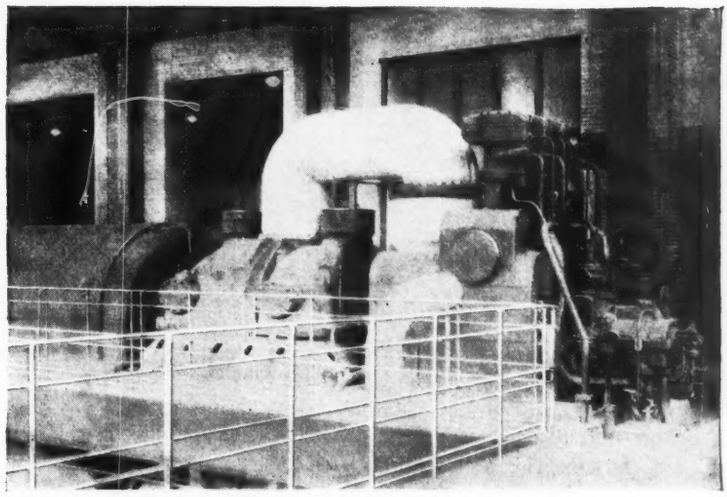


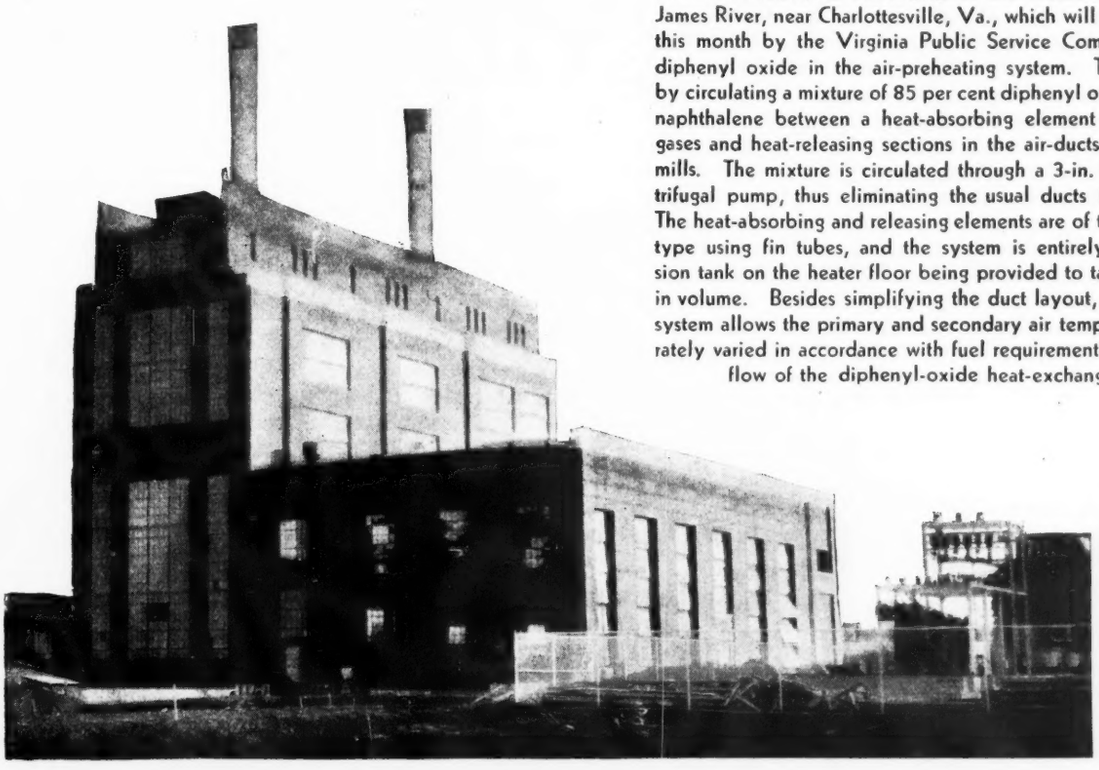
Fig. 16—Same as Fig. 14 with the cylinder barrel moved to the left

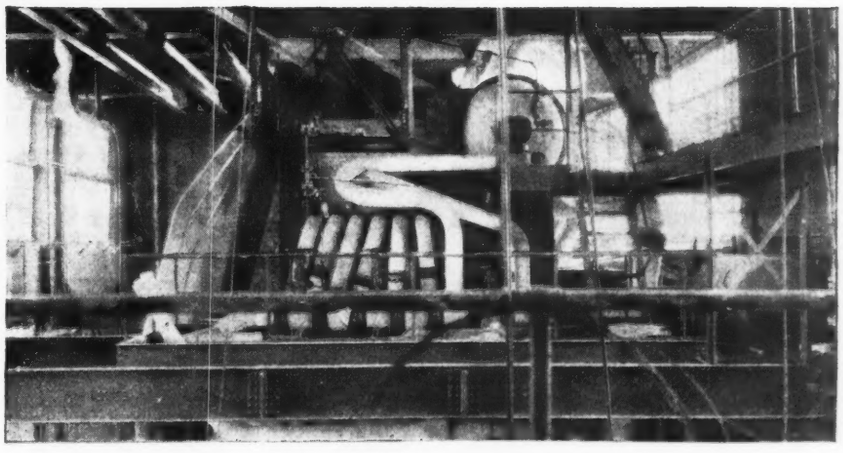
BREMO BLUFF STATION COMPLETED

Diphenyl Oxide Used to Preheat Air



AN INTERESTING FEATURE of the Bremo Bluff station, on the James River, near Charlottesville, Va., which will be placed in service this month by the Virginia Public Service Company, is the use of diphenyl oxide in the air-preheating system. This is accomplished by circulating a mixture of 85 per cent diphenyl oxide and 15 per cent naphthalene between a heat-absorbing element in the path of the gases and heat-releasing sections in the air-ducts to the furnace and mills. The mixture is circulated through a 3-in. line by a small centrifugal pump, thus eliminating the usual ducts from the air heaters. The heat-absorbing and releasing elements are of the extended-surface type using fin tubes, and the system is entirely closed, an expansion tank on the heater floor being provided to take care of variations in volume. Besides simplifying the duct layout, the diphenyl-oxide system allows the primary and secondary air temperatures to be separately varied in accordance with fuel requirements by controlling the flow of the diphenyl-oxide heat-exchanging mixture





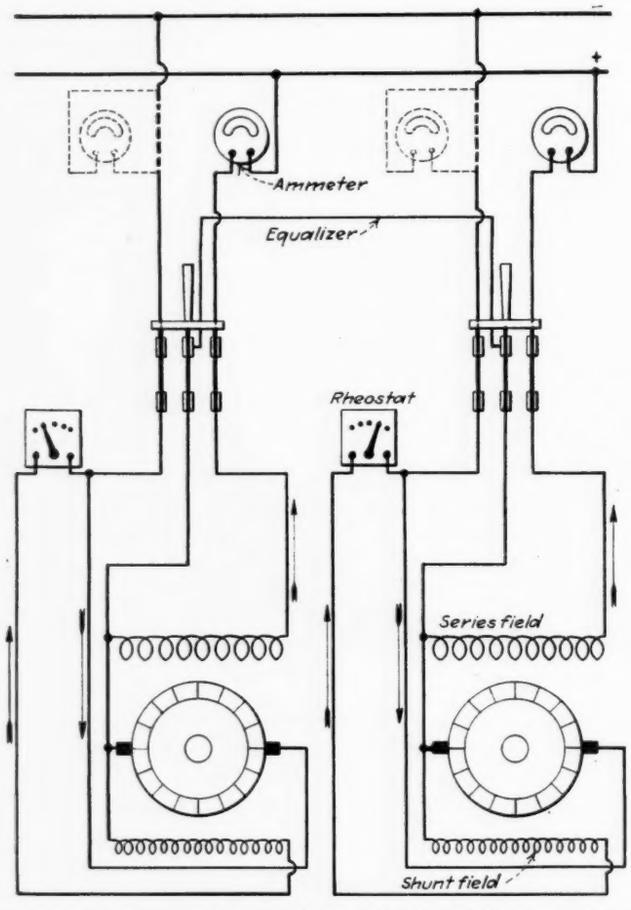
Initial installation comprises two 15,000-kw. tandem-compound condensing turbine-generators operating at 3,600 r.p.m. Each turbine is supplied with steam at 525 lb. and 750 deg. F. by an inclined-tube single-pass boiler with a normal output of 160,000 lb. per hour and a maximum output of 200,000 lb. per hour. Pulverized coal is used for firing with three pulverizers for each unit. The station is planned for an ultimate 150,000 kilowatts.

...RIGHT OUT OF THE PLANT...

Ammeters Wrongly Connected

TWO compound-wound direct-current generators of identical size and design were connected to run in parallel. The usual provision had been made for securing an even division of the load between the two machines, but, to the bewilderment of the operating engineer, the temperature of one generator usually was much higher than that of the other. And it was not always the same generator that showed the greater heat, nor did the ammeters indicate that one was carrying a heavier load than the other.

Upon investigation it was found that each ammeter was connected in circuit with the series field. That was



Ammeters improperly connected for showing division of load

why they registered alike when the overheating of one machine was an obvious indication that it was doing more work than its mate. The unbalance was due to faulty adjustment of the shunt fields, which, of course, the ammeters could not reveal. Whether one generator or the other carried the most load depended upon the relative amount of rheostat resistance cut in. But so long as the ammeters showed nothing wrong, the operator saw no reason to bother with the rheostats. Shifting the ammeters to the positions indicated by the dotted portions of the accompanying sketch, so that they were in series with the negative leads from the generators, cured the difficulty.

A. J. DIXON.

St. Louis, Mo.

Heat Balance in an Ice Cream Plant

WE HEAR and read a great deal about the heat balance in large central stations, power plants, etc., but I have never read anything about heat balance in an ice cream plant. So I shall endeavor to explain how I have saved a few B.t.u.'s in our plant.

An ice cream plant is probably one of the least efficient of manufactories, for several reasons. First, we must maintain low temperatures; second, the load factor is low, usually below 50 per cent, as the load depends almost entirely upon the weather, and, third, most of the work is done during a day of about ten hours. Under these conditions a proper heat balance is hard to obtain without equipment that would cost more than could be saved.

In our plant we have refrigerating capacity of 250 tons in ammonia compressors. Our steam boilers have a normal output of 8,000 lb. of steam an hour, but our average steam demand is only around 3,000 lb. an hour. Now the question is, how are we going to make the heat of compression of the ammonia assist our boilers in making steam. One boiler is operated usually from 6 a.m. to 6 p.m. and the compressors are operated during the same time.

We installed an ammonia desuperheater in the 5-in. discharge line between the compressors and the condensers. This desuperheater is 16 in. in diameter and 6 ft. long, having 42 $1\frac{1}{4}$-in. tubes, rolled in the heads, and three water passes. The water passing through this desuperheater is the boiler feed water, zeolite softened, with a 600-gal. storage tank on the roof maintaining a 12-ft. head of water on the desuperheater. The water after passing through the desuperheater flows to an open-type feed-water heater with a vent to atmosphere. Exhaust from the feed water and fuel oil pumps, and condensate returns from the pasteurizers also enter the heater.

The average rise in temperature of the water passing through the desuperheater is 72 deg. This temperature

varies with the load on the boilers, which determines the rate of water flow; with the load on the compressors, which determines the ammonia flow; and with the temperature of the ammonia gas passing through the desuperheater. To get the most from this system the operators must control the suction superheat within narrow limits, which have been laid out for them. The average day's run requires about 21,350 lb. of water for boiler feed make-up, all of which passes through the desuperheater. If this water is heated 72 deg. we have recaptured 1,537,200 B.t.u. and have relieved our condenser and cooling tower of that much load. If we consider 10 deg. rise in feed water as equal to 1 per cent saving in fuel, we have saved 7 per cent on our fuel bill.

There are other advantages to a desuperheater and feed-water heater. We have better oil separation from the discharge gas, which is a great advantage in a plant which maintains low temperatures; the separation is obtained by the lowering of gas velocity and cooling at the same time, which has the same action as an air dehydrator and will precipitate the liquid which the gas contains. The discharge line is 5 in., and when it enters the 16 in. the velocity of the gas is reduced in proportion to the increase of area, about 10 to 1. The gas, at the same time being cooled by the water passing through the tubes, precipitates the entrained oil. Another advantage is the reduced disintegration of the ammonia, thereby causing less non-condensible gas in the system and a lower head pressure.

In a steam-driven refrigerating plant, a greater saving could be made with a system just described, but even in our own we feel that it has justified the expense.

M. E. BELL, *Chief Engineer*,
Golden State Milk Products Co.
San Francisco, Calif.

Peak Load Capacity at High Efficiency From Bleeder Turbines

IN THE JAN. 20 NUMBER was published an abstract of a paper by A. G. Christie and W. Viessman pointing to the possibility of using feed-water accumulators in connection with bleeder turbines, for carrying higher peak loads than otherwise possible. These possibilities have already become realities in various German plants, and especially in the first 1,500-lb. power plant at Mannheim. I devised the scheme five years ago and the plant came into service in 1928.

The diagram of connections is illustrated in Fig. 1.

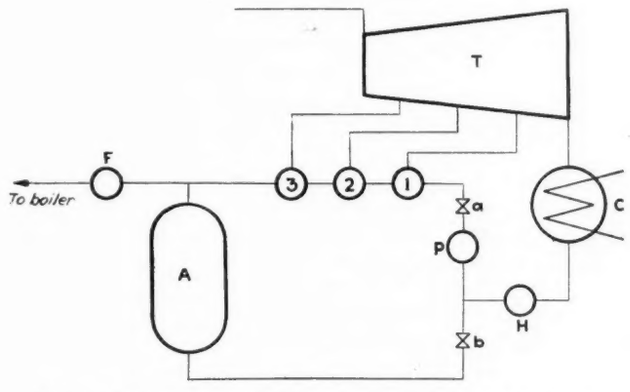


Fig. 1—Diagram of feed-water accumulators at Mannheim, Germany

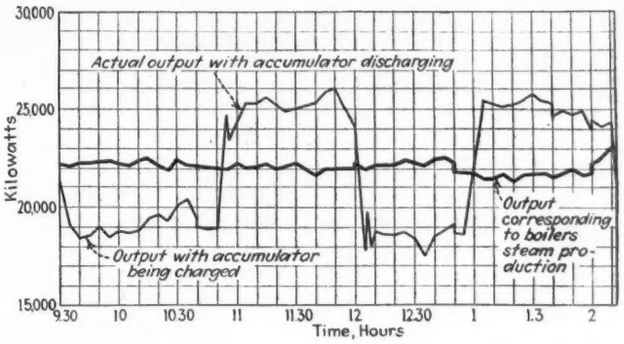


Fig. 2—Curves showing peaking capacity of accumulators

In principle it works similarly to the system described by the authors of the paper, but seems to have two very marked advantages. The first one: no necessity of increasing the capacity of the surge tank; and the second: possibility of running the system at the same time with bleeding and with water from the accumulator, so permitting of any partial unloading of the accumulator according to the requirements of the load.

In the simplified diagram T is the turbine, equipped with three bleeder heaters 1, 2, 3 and the condenser C. The hotwell pump H, designed for operation against the accumulator pressure, say 200 lb., pumps the condensate through the extraction heaters to the feed pump F, the valve a being open and b closed. The circulating pump P, laid out for a larger amount of water, say double the maximum supply of condensate, gives only a certain additional pressure in this case. When peak lead occurs the valve a is partly of wholly closed and b opened. The cold water enters by the bottom of the accumulator, forcing the hot water to go to the boiler-feed pump. The extraction steam is deflected from the bleeders to the condenser with corresponding increase in output. When the load goes down under the normal output, then both valves a and b are opened. Cold water taken from the bottom of the accumulators is passed through the bleeders and hot water restored to the top. Increased bleeding lowers the output of the turbine without changing the steam supply.

Fig. 2 illustrates a series of tests. The nearly horizontal line shows the output corresponding to the steam production of the boilers with normal extraction, while the fluctuating line shows the actual load. As will be seen fluctuations of 69 to 100 per cent were taken care of. In service the variation amounts to from 60 to 100 per cent. Of course, the scale of the test is still small. but it appears that in a big station variations from 170,000 to 270,000 kw. can be handled with the advantages pointed out clearly by Professor Christie.

Mannheim, Germany. Dr. Ing. F. MARGUERRE.

Large Leather Packings

IN THE Feb. 3 number of *Power* there appeared a photograph of a leather packing, measuring 102 in. in diameter. Inasmuch as this illustration was titled the world's largest packing, we wish to call attention to the fact that the E. F. Houghton & Company have manufactured flange packing 127 in. in diameter and "U" packings 125 in. in diameter for the Navy Department at Washington.

Philadelphia, Pa. J. N. SMITH,
E. F. Houghton & Co.

Welding Education

AS THE DISCUSSIONS on arc-welding of boiler seams, in the Feb. 24 issue, provoked a good deal of comment, both pro and con, on the merits of fusion welding the thought occurs that some of the readers of *Power* will be interested in the progress of educational programs for welders and welding supervision.

First, let it be stated that welding equipment manufacturers, federal and state school authorities, and the intelligent welders and welding societies are working side by side to further the progress of welding as the great industrial process it is destined to become. Through the American Welding Society and the local associations the practical welders have a medium for the quick exchange of ideas.

Among the educational institutions fostering the training of men in both the technical and the practical phases of welding the Denver Opportunity School is undoubtedly outstanding. It is the purpose of such an institution to give the men a thorough understanding of the chemical, physical and metallurgical phenomena encountered in industrial welding as well as skill in handling gas torches or electric welding generators.

The general welder in the repair field must have a thorough understanding of the use to which the welded article is to be put as well as skill in welding. Here a word of caution is advisable. Never put a welded article back into service without beforehand determining and eliminating the cause of the original failure. So, if a boiler seam starts leaking, it is best, before attempting a welding job, to discover what is the cause of such a leak. If the bad condition is allowed to persist unchecked the trouble will, of course, continue and reputations will suffer.

Merely exchanging welding for riveting in a fabricating or erecting shop is seldom advisable. This is one of the great advantages of welding. A skillful designing engineer can plan an all-welded steel building, tank or vessel so that a substantial saving in steel tonnage is achieved, with the same loading and factor of safety as in a riveted structure.

The history of welding shows that as a whole the industry has been awake to its own shortcomings in meeting certain problems, particularly in relation to pressure vessels. The welding industry has never given up or attempted to establish any but the best practices. When some hard problem came up, the industry fostered research and test by all interested parties until a safe and economical solution was found.

The tremendous possibilities of fusion welding are even now but dimly realized by the most capable and alert engineers and industrialists.

When pondering the possibilities of welding in one's own plant, the thing to remember is that the success of the weld is nearly 100 per cent dependent on the skill and character of the welder. On a job where the safety of human beings or large financial investment depend on the security of the weld only a high-grade, technically trained man should be employed.

Of course the capable, technically trained welder demands a higher wage, but paying a crew of these men a higher wage rate is economically sound as fewer foremen and inspectors are required and defective workmanship and consequent comebacks are reduced to the vanishing point.

Let industry be glad that through the co-operation of schools, manufacturers, and the welding societies and individual welders there are trained men, with years of practical experience to make that training count, who are ready to be in the front line of the next drive to secure lowered operating costs and better products.

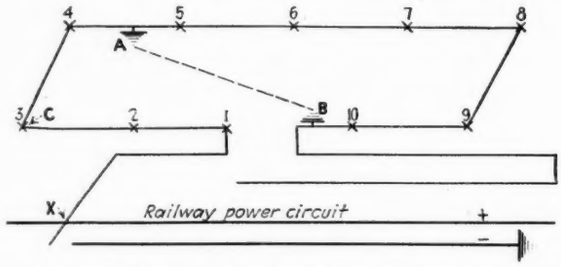
Denver, Colo. CARL A. WAGNER.

An Unusual Combination of Grounds on a Lighting Circuit

IN A SMALL TOWN that had changed the street-lighting system from lamps suspended over the center of the street to one using iron standards, with one lamp on top of each, a peculiar case of trouble developed. There were ten standards, five on each side of the street, set alternately as in the figure, with the ten lights connected in series, the wire being put underground to improve the appearance of the installation. Flexible single-conductor, lead-covered insulated cable with a protective steel sheath was used. Where it ran under street crossings it was put inside of iron conduit.

The ten lamps of the new system are in series with a number of others, and had been in operation for about a year when a ground fault developed as at *B* in the figure. This ground did not cause any trouble, and the linemen were busy with other work, so it was not removed. One night the regulator that controlled the circuit began to act erratically; finally, the circuit opened. Next morning, with the circuit open, the linemen set out to find where the line had failed. Going over the circuit they found lamps 1, 2, 3 and 4 burning at about half candlepower. The rest were out.

It was found that the wire feeding the lamps had broken, and came down across a street railway power



Simplified circuit diagram of the lamps on which the trouble occurred

circuit as at *X*. The insulation was so poor on the wires that there was sufficient leakage to cause the lights to burn half candlepower, through a ground later located at *A*. After clearing up the trouble the current was put on the street circuit, and it was found that lamps 5, 6, 7, 8, 9 and 10 were out and the other four were lighted. The current was turned off, and a testing showed a ground at *A*, and another at *B* which accounted for the behavior of the lamps.

When the trouble was cleared at *A* and the circuit tested again with the current on, lamps 1 and 2 were burning and the others were out. It was evident that another ground existed somewhere between No. 2 and 3 lamps. Investigation showed a wire grounded on the lamp case standard at *C*. This was cleared up, and upon putting the current on again all the lamps lighted. A ground still existed at *B*, but owing to the ground's being frozen it was decided to let it go until the spring.

Brunswick, Me. LEON L. POLLARD.

Quality Welding Is Keynote of A.W.S. Meeting

Annual meeting of welding society reveals general advance of application technique in many fields

A GENERAL ADVANCE in application technique in many welding fields was revealed in papers presented before the annual meeting of the American Welding Society held in New York April 22-24, inclusive. It there became increasingly evident that leading equipment manufacturers, as well as welding users, are seeking, through codes, special tests, scientific research and the training and qualification of welders, to insure welding work of distinctly higher quality than other forms of attachment. This aspect of welding was particularly stressed in papers on the welded-drum boilers for United States Navy scout cruisers and on the welding of heating and industrial piping.

A feature of the meeting was the annual dinner, held at the Hotel New Yorker and attended by more than 250 members and guests. On Saturday, after completion of the technical session, many members participated in an inspection trip to the New York Hospital and Cornell medical group. This project involves over 50,000 ft. of welded piping, ranging in size from 2½ in. to 24 in., for the transmission of hot water, brine and steam for low-pressure and high-pressure service.

E. A. Doyle Reelected President

At the opening business session on Wednesday morning the tellers' committee announced reelection of E. A. Doyle as president of the society and the election of other officers (including reelections) as follows: Senior vice-president, F. P. McKibben; treasurer, C. A. McCune; secretary-assistant treasurer, M. M. Kelly. Divisional vice-presidents—New York and New England, C. W. Babcock; Middle Eastern, W. W. Barnes; Middle Western, H. A. Woofter; Southern, H. C. Price; Pacific Coast, W. A. F. Millinger.

Members of the board of directors and of the executive committee, as well as chairmen of standing committees for the ensuing year, are listed at the end of this report.

Incorporation of the society was voted by the membership and preliminary steps toward that end were taken.

In all, twelve papers, as follows, were presented at the meeting: "Welded Boilers for United States Navy Scout Cruisers," "Welded Machinery Foundations for Ships," "Welding in Structural Steel Work," "Formulas for Eccentrically Welded Connections," "Tests of Gas-Welded Structural Joints," "Resistance Welding Problems," "Strength and Characteristics of Structural Connections," "Welding of High-Pressure Heat Exchangers," "Welding of Heating and Industrial Piping," "Thermit Welding and Maintenance in the Steel Mill," "Metal Arc-Welding of Copper Alloys" and "High-Tensile Atomic Hydrogen Arc Welds in Alloy Steel."

Welded Boilers for Scout Cruisers

Of great interest to power engineers was the paper on welded boilers for United States Navy scout cruisers, presented by J. C. Hodge of the Babcock & Wilcox Company. The order for these boilers, announced late last year, was looked upon as a highly significant event in the boiler and welding field. In ordering welded-drum boilers for 24 boilers to be used in the new scout cruisers Minneapolis, New Orleans and Astoria, the Bureau of Engineering prepared a specification based upon the proposed A.S.M.E. specifications for fusion-welding of drums or shells of power boilers. The Navy Department specifications, however, included certain variations.

Further information regarding the construction and testing of the scout-cruiser boilers will be given in an early issue of *Power*. It should be pointed out here, however, that Mr. Hodge's paper stressed the desirability of the X-ray test required by the specifications. Of 24 boiler drums constructed, the X-ray revealed defects in one, resulting in rejection of the weld.

Mr. Hodge called attention to the orders received for eight boilers for a fourth scout cruiser and for six boilers for the aircraft carrier CV4. These are in addition to those for the three scout cruisers already mentioned.

The working pressure of the boilers is 320 lb. per square inch. The welded steam drums have an internal diameter of 47⅜ in., are 13 ft. 9⅜ in. long, and made of plate 1$\frac{5}{32}$ in. thick.

Is X-Ray Test Necessary?

The discussion of Mr. Hodge's paper centered largely around the value and necessity of X-ray tests, thus bringing to the surface a controversy that has been lively behind the scenes for some weeks. Some manufacturers have looked upon the X-ray test as burdensome and unnecessary. Others have welcomed the requirement.

In the discussion Ancel St. John, president of the St. John X-Ray Service Corporation, declared that Mr. Hodge's paper showed the importance of verifying even the best of welding processes by X-ray examination. He stressed this test as a means of giving assurance to the buyer and stated that the X-ray can detect a cavity constituting only 2 per cent of the total thickness.

C. W. Obert, consulting engineer, Union Carbide & Carbon Laboratories, said that the X-ray requirement has been helpful in securing government and state cooperation toward the authorization of welded boilers. He said that gamma rays and magnetic analysis are also being considered by the Boiler Code Committee, but that the X-ray test is the furthest advanced at the present time. He also declared that the X-ray has helped the code committee to avoid the difficult problem of welding processes. By specifying result rather than process it has been able to avoid discrimination against any type of process or method of welding. Finally, Mr. Obert stated, the X-ray requirement is not as burdensome as might appear at first sight, since it applies only to boiler drums and to other Class A vessels having a shell thickness of 1½ in. or more. Thus under the proposed code the great majority of pressure vessels may be welded without X-ray inspection.

Interesting comments, growing out of long contacts with ship-welding and with the United States Navy Bureau of Engineering were made by J. W. Owens, director of engineering, the Welding, Engineering & Research Corporation. He looked upon it as a remarkable thing that the Bureau, noted for its conservatism, has led the way in accepting welded boilers. This, he felt, proves the value of detailed specifications and of non-destructive tests.

Cost of X-Ray Tests

Discussing the paper, E. A. Doyle, president of the society and consulting engineer for the Linde Air Products

Company, referred to the current controversy over the necessity and cost of X-ray inspection. He noted some swing of sentiment toward the X-ray. The question now is, he said, who is going to pay for the testing. He felt that the buyer will be willing to pay for this testing and that this willingness will largely do away with objections.

Mr. St. John agreed that the user must necessarily carry the cost of X-ray and other tests. In return he gets not only added security, but the ability to make sure he is getting what he pays for.

The cost of X-ray inspection of 1-in. thick plate was given by Mr. Hodge as about 50c. per running foot of weld, including all fixed charges and labor. The Sperry method of electric testing was pronounced satisfactory by Mr. Hodge. He said, however, that it is harder to sell to the user, who has greater difficulty in visualizing its value.

Welded Heat Exchangers

The application of fusion welding to high-pressure heat exchangers was illustrated in a paper by Marselis Powell, of the Whitlock Coil Pipe Company, who showed many examples of welded heat exchangers. "Careful study and test applications have shown," said Mr. Powell, "that by properly placing the weld and designing the parts of a vessel or heat exchanger it can be made to have practically equal strength in all places." Flanges, he said, are preferably provided with integral welding necks so that the weld may be of the straight butt type rather than a fillet weld.

Mr. Powell said that it is the custom of his company, when attaching the nozzle to the shell, to reinforce the shell by a ring on each side of the nozzle, these rings being welded to both the shell and nozzle. For high working pressures he described the method of strengthening nozzle welds by flaring or belling either the end of the nozzle or the edges in the opening of the shell, as a reinforcement and as a means of removing the weld from the point of greatest stress.

An interesting welding application mentioned by Mr. Powell was the insertion of a bumped head into the shell of an ammonia receiver with the convex side inward. The head is attached by a fillet weld. This placing of the head makes it possible for the head to bulge out to provide for the possibility of the receiver's being closed off tight when practically full of liquid. Actual tests to destruction on receivers of this design have resulted in completely reversing the bumped-head curvatures without disturbing the weld, said Mr. Powell.

Mr. Powell's paper described methods of producing light-weight floating heads by welding and of welding tubes directly into tube sheets where permanent tightness is required at high pressures and temperatures.

"Welding," he said, "plays a very important part in the manufacture of steel coils used extensively as heat exchangers. Before bending, the pipe is made continuous by welding." He concluded by saying that the use of welding in the manufacture of heat-exchange apparatus has, in general, simplified the problem of design, in many cases has lowered the cost of manufacture, has done away with troublesome leaks peculiar to riveted joints, and, finally, has reduced the time required to build the equipment.

Lively Discussion on Piping Code

One entire technical session was devoted to a discussion of the proposed welding section of the code for pressure piping formulated by a sub-committee of the American Welding Society at the request of a sub-committee of the American Standards Association. The code presented at the meeting for discussion is intended, when finally revised, to form a part of the complete code for pressure piping. The discussion, which was actively participated in by members of the American Welding Society, the American Standards Association, and the American Society of Mechanical Engineers, was, in general, of too detailed a nature to be understood without reference to the complete code. In this discussion it became clear, however, that many views exist regarding these details and that the completion of this code will be a difficult task.

Much of the discussion centered about a temperature limit of 750 deg. F for welded piping. Some felt that this temperature should be lowered to 500 deg. Others felt that 750-deg. limit is satisfactory, and still others proposed a much higher limit.

Detroit Edison to Use Welded Piping on 1,000-Deg. Unit

In this connection interest was shown in the statement by H. S. Walker, research engineer, Detroit Edison Company, that his company will use welded piping for high-temperature steam. It is planned to use all-welded steel piping for the new 850-deg. plant and welded stainless-steel piping for the unit which is to operate at 1,000 deg. Mr. Walker said that welding was adopted for these lines after it was discovered that ordinary flange connections would not be satisfactory.

A written discussion sent in by A. L. Penniman of the Consolidated Gas, Electric Light & Power Company, Baltimore, declared that there is no reason to limit the temperature to 750 deg. Mr. Penniman objected strenuously to sleeve reinforcement. He pointed to the danger of using air in testing.

Speaking at the same session, J. H. Zink, chairman of the welding committee of the Heating and Piping Contractors National Association, presented a paper on the welding of heating and industrial piping and made many comments on the proposed code.

Zink Assails Trade Practices

Mr. Zink's paper was notable as a forceful criticism of certain trade practices and sales policies. He said that there is too much tendency to encourage incompetent and unscrupulous contractors to engage in welding. He said also that users should not attempt welding for themselves unless properly equipped.

Mr. Zink felt that educational efforts should be concentrated on the responsible contractors rather than on the mechanic. He hoped that some way might be found to certify welding rods and pointed to the danger incurred in the use of inferior rods. He objected to square butt welds and felt that the single-vee weld with ends separated at the bottom is best for most pipe work. For flange connections he recommended the welding neck flange and the Van Stone.

For right angle turns Mr. Zink said that he would never use the simple square "stove-pipe" bend. Neither did he consider the double-mitre bend very desirable for general use, because of the unwillingness of workmen to use templates. He recommended wider use of new welding fittings now coming on the market, including plugs, reducers, ells, tees, etc.

Mr. Zink strongly opposed the reinforcement of welds as a confession of incompetence. He decidedly favored machined bevels over those cut on the job with a torch.

In a paper on high-tensile atomic-hydrogen arc welds in alloy steels, Frederick Ray, consulting engineer, Croll Reynolds Engineering Company, described some remarkably ductile and high-strength welds made by that process. The paper was presented by Mr. Croll. He exhibited welds made in high-pressure expansion joints which had an ultimate strength of 160,000 lb. per square inch and resisted reversing stresses indefinitely without failure.

New Officers Named

In addition to the president and vice-presidents, listed on page 711, the following directors, executive committmen and standing-committee chairmen will serve during the ensuing year:

Board of Directors—A. M. Candy, J. H. Deppeler, E. H. Ewertz, F. M. Farmer, A. E. Gaynor, C. A. Adams, H. M. Hobart, A. G. Oehler, J. W. Owens, J. J. Crowe, W. H. Gibb, F. T. Llewellyn, H. S. Smith and W. C. Swift.

Section Directors — Boston, T. A. Wry; Chicago, W. A. Slack; Cleveland, J. A. McCullough; Detroit, H. A. Woofter; Los Angeles, P. E. Jeffers; New York, P. W. Swain; Northern New York, L. D. Meeker; Western New York, F. L. Rodgers; Philadelphia, R. D. Thomas; Pittsburgh, H. D. Kelley; Portland, L. C. Thomas; San Francisco, R. H. Atkinson.

Members of Executive Committee—E. A. Doyle, J. J. Crowe, J. H. Deppeler, F. H. Ewertz, F. M. Farmer, G. D. Fish, A. E. Gaynor, W. H. Gibb, F. T. Llewellyn, Ernest Lunn, C. A. McCune, F. P. McKibben, A. G. Oehler, H. S. Smith, P. W. Swain, E. Vom Steeg and H. A. Woofter.

Chairmen of Standing Committees—Executive, E. A. Doyle; Finance, C. A. McCune; Membership, A. E. Gaynor; Revision of By-Laws, A. M. Candy; Meetings and Papers, P. W. Swain; Committee on Code of Principles, E. H. Ewertz.

Water-Power Calculations Simplified

By ROBERT BALL

THE EFFICIENCY at which water in motion is converted into useful power varies greatly. The highest attainable efficiency from forebay to generator terminals is approximately 93 per cent. Under unfavorable conditions this value may be reduced to 50 per cent. Due to load variations and irregular stream flow, few generating units can be operated at maximum over-all efficiency for long periods. The efficiencies used in computations must correspond to actual operating values.

Table I gives efficiencies that can be expected at full load with high-head equipment and very long penstocks. It is assumed, in this case, that water is

TABLE I—FULL LOAD EFFICIENCIES

	Input in Kw.	Output in Kw.	Unit Efficiency
Headgates and penstocks	100	96	96.0
Turbines	96	80	83.4
Generators	80	78	97.5
Transmission lines and transformers	78	69	88.5

economically utilized under 1,175-ft. head. Under that head one second-foot would develop 100 kw. at 100 per cent efficiency. It will be noted that 78 kw. is available at the generator terminals, and 69 kw. at the terminals of the step-down transformers. Then the unavoidable losses from forebay to substation amount to 100 — 69 = 31 kw. per sec.-ft. at full load.

The weight of water is usually taken as 62.5 lb. per cubic foot. One cubic foot per second (second-foot) of water falling 1 ft. will develop, at 100 per cent efficiency, $\frac{62.5}{550} = 0.114$ hp., the factor 550 being the foot-pounds in a horsepower-second. The power available from falling water is obtained by the formula: $Hp = H \times sec.\text{-}ft. \times 0.114 \times \frac{E}{100}$ where H = the head in feet and E = per cent efficiency of conversion. Then, if the head $H = 1{,}250$ ft., the flow equals 960 sec.-ft. and the efficiency $E = 78$, then $Hp. = 1{,}250 \times 960 \times 0.114 \times \frac{78}{100} = 106{,}700$.

One horsepower equals 0.746 kilowatt; then by multiplying $0.114 \times 0.746 = 0.085$ is obtained, and we can write

$$Kw. = H \times sec.\text{-}ft. \times 0.085 \times \frac{E}{100}$$

For example, if the head $H = 55$, the quantity of water equals 25,000 sec.-ft. and the per cent efficiency $E = 74$, then the kilowatts, $Kw. = 55 \times 25{,}000 \times 0.085 \times \frac{74}{100} = 86{,}500$.

In exact terms, an acre is a rectangle 220×198 ft., or 43,560 sq.ft. An acre-foot of water is that volume that will cover this area to a depth one foot, or 43,560 cu.ft. There are $24 \times 60 \times 60 = 86{,}400$ sec. per day. Hence, 1 sec.-ft. flow for 24 hr. is the equivalent of $\frac{86{,}400}{43{,}560} = 1.992$, or 2 acre-feet.

The rate of flow required to discharge 1 acre-ft. in 1 hr. is $\frac{43{,}560}{60 \times 60} = 12.1$ sec.-ft., and the energy available from 1 acre-ft. under 1-ft. head at 100 per cent efficiency is $12.1 \times 1 \times 0.085 = 1.029$ kw.-hr. One million gallons of water occupies a volume of 133,681 cu.ft., or 3.07 acre-ft., and under 1-ft. head at 100 per cent efficiency would produce $\frac{43{,}560}{133{,}681} \times 1.029 = 3.156$ kilowatt-hours.

By using the constants in Table II opposite the efficiency at which water is utilized the power can be quickly ob-

TABLE II—POWER AVAILABLE FROM WATER AT DIFFERENT EFFICIENCIES

Eff. At Which Water Is Utilized Per Cent	Power Available From 1 Sec. Ft. Under 1-Ft. Head		Energy Available Under 1-Ft. Head Kw.-Hr.	
	Hp.	Kw.	Per Acre-Ft.	Kw.-Hr. Per M.Gal.
A	B	C	D	E
100	0.114	0.085	1.029	3.156
98	0.112	0.083	1.008	3.093
96	0.109	0.082	0.988	3.030
94	0.107	0.080	0.967	2.967
92	0.105	0.078	0.947	2.904
90	0.103	0.077	0.926	2.840
88	0.100	0.075	0.906	2.777
86	0.098	0.073	0.885	2.714
84	0.096	0.071	0.865	2.651
82	0.094	0.070	0.844	2.588
80	0.091	0.068	0.823	2.525
78	0.089	0.066	0.803	2.462
76	0.087	0.065	0.782	2.399
74	0.084	0.063	0.763	2.335
72	0.082	0.061	0.741	2.272
70	0.080	0.060	0.721	2.209
68	0.078	0.058	0.700	2.146
66	0.075	0.056	0.679	2.083
64	0.073	0.054	0.659	2.020
62	0.071	0.053	0.638	1.957
60	0.069	0.051	0.617	1.894
58	0.066	0.049	0.597	1.822
56	0.064	0.048	0.576	1.767
54	0.062	0.046	0.556	1.705
52	0.059	0.044	0.535	1.641
50	0.057	0.043	0.515	1.578

tained. The formula for horsepower, using the constants in the table, is $Hp. = H \times sec.\text{-}ft. \times B$. Then if $H = 2{,}400$, $sec.\text{-}ft. = 1{,}250$ and $E = 74$, (an efficiency of 74 per cent corresponds to constant 0.084 in column B), $Hp. = 2{,}400 \times 1{,}250 \times 0.084 = 252{,}000$ horsepower.

By substituting constant C for constant B in the formula the output in kilowatts will be obtained. For example, if $H = 1{,}100$, $sec.ft. = 1{,}600$ and $E = 80$, $Kw. = 1{,}100 \times 1{,}600 \times 0.063 = 110{,}880$ kilowatts.

The energy available from any number of acre-feet can be found from the formula: $Kw.\text{-}hr. = H \times acre\text{-}ft. \times D$. If $H = 1{,}050$, $acre\text{-}ft. = 44{,}000$ and $E = 74$; constant D, corresponding to 74 per cent efficiency, being 0.763, then $Kw.\text{-}hr. = 1{,}050 \times 44{,}000 \times 0.763 = 35{,}250{,}600$ kilowatt-hours. Constant E is used for calculating the kilowatt-hours when the available water quantity is given in millions of gallons.

From Table III the volume, both in acre-feet and in millions of gallons, that will result from water flowing from 1

TABLE III—VOLUME OF WATER RESULTING FROM FLOW OF ONE SECOND-FOOT

Duration in Hr.	Volume of Water Resulting From Flow of 1 Sec.-Ft. Acre-Ft.	Mil. of Gal.
A	B	C
1	0.083	0.027
2	0.166	0.054
3	0.249	0.081
4	0.332	0.108
5	0.413	0.135
6	0.496	0.162
7	0.571	0.189
8	0.661	0.216
9	0.744	0.243
10	0.830	0.270
11	0.909	0.297
12	0.999	0.324
13	1.072	0.351
14	1.159	0.378
15	1.240	0.405
16	1.322	0.432
17	1.405	0.459
18	1.489	0.486
19	1.570	0.513
20	1.660	0.540
21	1.738	0.567
22	1.820	0.594
23	1.900	0.621
24	1.992	0.648

to 24 hr. can be easily calculated. It will be noted that 1 sec.ft. flowing for 1 hour $= \frac{3{,}600}{43{,}560} = 0.083$ acre-feet.

As a problem, find the volume of water in acre-feet and in millions of gallons that would accumulate if 820 sec.-ft. flowed for 22 hr. $Acre\text{-}ft. = 820 \times 1.820 = 1{,}492$, and $millions\ of\ gallons = 820 \times 0.594 = 487$.

▼

Britain's National Power Survey Almost Complete

IN ITS REPORT for 1930 the Central Electricity Board of Great Britain states that "to all intents and purposes, the initial survey of the country is now almost complete. The board's activities have been set in motion in almost every area."

The eight schemes have been adopted covering 71.8 per cent of the total area of the United Kingdom and 97.6 per cent of the total population.

Last year 1,000 miles of wayleaves were secured, as well as 70 sites for transforming stations. Further contracts for works in connection with the grid were let at a total cost of $38,190,685, making the total value of such contracts up to Dec. 31, 1930, $91,339,145. During the next few years about $50,000,000 is to be spent on standardization of frequency by the supply undertakers affected.

From Among Readers' Problems

Conducted by
L. H. MORRISON

WATER IN LIQUID AMMONIA—*I believe there is considerable water in the ammonia in our refrigerating plant. How can it be detected?* S.P.

In order to test for moisture in the liquid ammonia use the following method:

Draw a sample of 50 c.c. from the charging valve into a test bottle. This bottle should be graduated to show the amount of 50 c.c. and also arranged to determine the percentage of moisture in the gas after the sample has been evaporated. The bottle is provided with a rubber stopper with a glass vent tube through which the gas escapes during evaporation.

After drawing the sample and inserting the stopper, hang the bottle on any convenient shaded wall until approximately one-third of the sample is evaporated. Then place the bottle in a bucket of brine at 60 deg. F., taken from the tank or brine system, in order that the sample will be evaporated as quickly as possible. As soon as the evaporation stops, the bottle can be removed from the brine and the percentage of moisture noted. If placed in the brine at the beginning the rapid boiling might cause some of the water to be lost.

Care is necessary to draw the sample into a dry bottle and to place the stopper in the bottle at once. A very little moisture in the bottle or a brief exposure of the sample to the atmosphere will cause an accumulation of moisture and give a false indication of the moisture content. In case a standard test bottle is not available, testing can be approximated in an ordinary bottle of known volume.

INCREASED TURBINE STEAM RATE—*Our turbine has been operating satisfactorily, but recently the steam used per kilowatt-hour has jumped 20 per cent. What is the reason?* C.V.

Assuming that the boiler pressure and the condenser vacuum has been unaltered, there is reason to believe that either the throttle valve has become deranged so that it wire-draws the steam, or a row of the blades has been lost, or fouling of blades may cause the trouble.

DIRECTION OF ROTATION OF COMPRESSOR—*In our plant a 16x24-in. horizontal ammonia compressor runs under. Should it not run over as does a steam engine?* F.P.

A horizontal compressor should run under, not over as in the case with a steam engine. When running under, the pressure exerted by the crank, through the connecting rod, upon the crosshead guide is downward. This makes the machine run quieter.

In adjusting the crosshead shoes remember that the wear is almost entirely upon the lower shoe. This shoe alone needs to be adjusted.

POWER OF SYNCHRONOUS MOTORS—*We have a synchronous motor with the exciter mounted on the same shaft. How can I find out the horsepower? Should I take off the load the exciter handles? The motor's nameplate data are: 600 kva., 60 cycles, 2,200 volts, 158 amp., 257 r.p.m., 80 per cent power factor, and the exciter nameplate rating is 125 volts, 96 amp. The power factor meter on the motor indicates unity. If an induction motor is connected on the same line, about 25 ft. from the power factor meter, should the meter still show unity power factor?* P.I.

The horsepower load that the motor can carry is equal to its kilovolt-ampere rating times 1,000 times the power factor times the efficiency divided by 746. In your problem the power factor is unity and the motor's efficiency, at full load, will be about 0.92. Therefore, the full-load horsepower of the motor is equal to $(600 \times 1{,}000 \times 1 \times 0.92) \div 746 = 740$ hp. At 80 per cent power factor the full load horsepower rating of the motor would be 80 per cent of 740, or about 600 horsepower.

If the power-factor meter is connected to read the power factor of the synchronous motor, this reading will not be affected by any other equipment on the circuit. The induction motor to which you refer will not affect the reading of the power-factor meter.

HEAT LOSS THROUGH ENGINE VALVES—*Is it a fact that the air drawn into an oil engine cylinder will be cooler if the valve is open during the entire suction stroke than if it is kept closed until the piston almost completes its stroke?* L.M.R.

Yes, the air will experience less cooling in the second method. The reason is due solely to the work performed by the air. When the piston starts on its suction stroke, with the inlet valve open, atmospheric air rushes in and performs work in forcing the piston in its travel. This work is accomplished at the sacrifice of some of the internal heat of the air, and the air cools, although but slightly.

If the piston has reached the end of its stroke before the inlet valve opens, the air rushes in at a considerable velocity, and since no work is done by it, it contains its original change of heat, so no cooling results. Of course, the absorption of heat from the iron parts may upset this theory to some extent. In one case the process is an adiabatic expansion and in the second an expansion without work being down.

PREVIOUS QUESTIONS DISCUSSED BY READERS

1. *I AM AN operating engineer, 48 years old, of at least fair ability. Due to a merger our factory is closed, throwing me out of a job. As I am over the economic age limit, should I seek engineering work or try something else?* A.P.C.

I SHALL ATTEMPT to answer the inquiry by stating my own age. I am twelve years older than A.P.C., and was chief engineer in several important plants for many years. When it became necessary to secure another position some time ago it was not long before I learned that a man 60 years old had small prospect of power plant employment, despite the first-class records I had to show from my former employers.

As a final solution, at an expenditure of $10 I started a nickle-plating business which is developing to a point where it will pay far more than I ever earned as an engineer. Few householders know that worn tableware and other metal objects can be made like new, at a small cost, by plating.

There are many ways in which a man of average intelligence can earn a good living. This is, in my opinion, one of the best—it costs little, and all that is necessary to know can be learned in a few hours. Silver and gold plating can also be done. I intend to do that soon.

Toronto, Can. JAMES E. NOBLE.

THAT a man 48 years of age should lose his job as an engineer because of the merger of his company with that of another, no doubt makes him feel that he has been following the wrong line of work during his more active days.

While it may seem to him that he has been harshly dealt with in his engineering work, if he will look about him he will find that men in other professions are experiencing the same difficulty.

He will probably have to accept a job a little lower than that of operating engineer, but there is no reason at all why he cannot soon work his way back to his previous rating, or even above. This advancement should prove even easier than before if the engineer will bear in mind that he has fewer active years ahead of him than when he first entered the profession. This should prove an incentive toward more effort on his part, which, coupled with his years of experience, should be a big benefit to the man. R. F. SORRELLS.

Beaumont, Texas.

AS A CONTRAST to the age element presented in the question, allow me to cite the case of a young man. Being in my early twenties I have experienced extreme difficulty at times in getting a job as an engineer because I am too young. Employers feel that if they hire a young engineer they place in his hands a responsibility that they feel is too much for him. The result is that nine times out of ten they do not hire him, although he may be capable of handling the job as efficiently, and surely more energetically, as an older man.

I became convinced that the solution of both problems lies not in the fact that the age factor matters but that the man must *sell* himself. The man who is sure of himself and of what he knows will convey that impression to a prospective employer. ROBERT S. CROMLEY.

Lyndhurst, N. J.

A MAN gets old because he allows himself to do so. Eighteen months ago I was informed by the company I worked for that it was going to buy its power. I was getting $40 a week. In a few days I found another job at $45, so I lost nothing by the firm's buying power.

There were men twenty years younger who were after my present job, but though 68 years old I won out. I pass for several years younger than I am, for I have retained my appearance and physical activity. I know quite a number of engineers who are not neat and clean in their appearance at work; they move around in a careless manner, impressing the manager with the idea theirs is a dirty, hard job. I believe if the engineer would brisk up and not allow himself to get old he would stay young much longer. C. W. RIGHT.

Boston, Mass.

A Question for Our Readers

WE PURCHASE all our power and now find that we need a supply of direct current amounting to about 50 kw. It happens that we still have in the factory a 50-kw. automatic steam engine direct connected to a direct-current generator. One of the men suggests that we connect this to the air line and operate it on air from our compound compressors driven by synchronous motors. Will the engine operate as economically as will a motor-generator set, considering all losses?

Suitable answers will be paid for and published in the June 16 number.

2. *WHAT furnace volume should one use with a 1,500-sq.ft. water-tube boiler, for 200 per cent rating, burning high-volatile bituminous coal on an underfeed stoker?* C.D.R.

IT SHOULD be recognized that the question of furnace volume involves more than a simple statement of a certain number of cubic feet. The chief requirements for obtaining good combustion in a furnace are that the length of travel of the burning gases rising from the fuel bed be great enough so that combustion can be completed before these gases come into contact with the cool boiler surfaces, and that the shape of the furnace be such as to aid in obtaining intimate mixture of the combustible gases with the oxygen-bearing air. The question of length of travel of the burning gases also involves the quantity and the velocity of the gases flowing; in other words, the fundamental requirement here is that sufficient time be allowed for the completion of the combustion of the gases before they are allowed to come into contact with the boiler surfaces.

It follows, then, that a number of satisfactory furnaces might be designed for this boiler, varying considerably in cubic content.

A 1,500-sq.ft. water-tube boiler operating at 200 per cent rating would transfer 10,043,700 B.t.u. per hour through the boiler surfaces. If an efficiency of 75 per cent for boiler and furnace be taken as a reasonable figure, the heat released in the furnace will be $10,043,700 \div 0.75 = 13,391,600$ B.t.u. per hour.

A heat release rate of 30,000 B.t.u. per cubic foot per hour, which is a conservative figure, would dictate a furnace volume of about 446 cu.ft. A rate of 40,000 B.t.u. per cubic foot per hour, an average figure for underfeed stokers, would require 335 cu.ft., while a rate of 50,000 B.t.u. per cubic foot per hour, which has been used without water-cooling of the walls, would require 268 cu.ft. So a satisfactory furnace could be designed for any volume between, say, 265 and 450 cubic feet.

At the higher rates of heat release the upkeep of the furnace walls and the draft loss through the furnace would probably be greater. On the other hand, the first cost of the smaller furnace would probably be less, so that a compromise would have to be made between these opposing factors.

In choosing the length of the furnace, in the direction of the flow of the burning gases, more definite information as to the flame characteristics of the fuel to be burned would be desirable, and could be obtained from other users of this fuel. With a satisfactory length chosen, and the size of the stoker known, the size and shape of the furnace could be laid out to give a volume somewhere between the limits of 265 and 450 cu.ft., due consideration being given to the structure of the boiler and costs of construction and of upkeep of the furnace walls. F. N. CALHOON.

Ann Arbor, Mich.

DUE TO the air passing through the incandescent fuel bed resulting in a very rapid combustion, underfeed stokers give just as high efficiency with small furnaces as with large furnaces, provided the small furnace has water-cooled walls and the boiler is designed to form a slag screen across the top of the furnace. This will reduce the action of slag bridging across the tubes causing a high draft loss and high furnace temperature that will rapidly melt down the furnace walls.

None of these conditions is given in the question. I shall assume that it is to be a standard boiler without any special spacing of the tubes to form slag screens, and is to have a solid brick furnace without air or water cooling. A heat release of 35,000 B.t.u. per cubic foot of furnace volume at 200 per cent rating will be assumed. This is low enough not to cause an excessive furnace temperature and high furnace maintenance, and not too low if at times the boiler is to operate at lower ratings only. Now all that is required is to work out a furnace that will give the required heat release. At 200 per cent rating the heat release will be $3.45 \times 2 \times 970.4 \times 1,500 = 10,043,640$ B.t.u. per hour.

The B.t.u. quantity required in the fuel fired is greater than that carried away in the steam, and the efficiency figure is a measure of how much greater. Assuming an efficiency of 72 per cent, we need a furnace of $\frac{10,043,640}{0.72 \times 35,000} =$ 400 cu.ft. (approximately).

Louisville, Ky. JAMES M. LYLE.

THE ENGINEER'S

Boiler-Room Chemistry

THE CHEMICAL TECHNOLOGY OF STEAM-RAISING PLANT. *By Henry Norman Bassett, chief chemist of the Egyptian State Railways. Published by Longmans, Green & Company, 55 Fifth Ave., New York City; 1931. Cloth, 6x9 in.; 240 pages, diagrams and tables. Price, $5.*

BEING himself a chemist, the author naturally looks upon boiler-room operation as primarily a chemical job. In fact, he considers chemical education plus engineering experience the ideal training for the man who supervises steam generation. This view may be somewhat extreme, but all must admit that chemical problems, particularly those of feed water, corrosion, and combustion, are major problems in boiler plants. The book deals with all of these subjects.

The largest portion of the book, however, and by far the most important, deals with feed water and closely associated subjects. Some attention is given to the geology of water supplies, a subject not well understood by many power engineers. Various methods of water treatment are given extensive consideration, as is the problem of corrosion in boilers, economizers and condensers.

As already pointed out, a portion of the book is devoted to combustion and composition of flue gases. Short sections deal with recording instruments, boiler testing, furnace linings and boiler laggings, and materials of construction.

Few modern books deal adequately with water treatment and corrosion from the viewpoint of the boiler-house. Problems continually arising in practical operation create a demand for such information. Mr. Bassett's volume will therefore be of interest to many American engineers.

It should be pointed out that the author is British, and that his book presents a British point of view. Numerous references are made, however, to work done in the United States and elsewhere.

Internal Combustion Engines

INTERNAL COMBUSTION ENGINES. *By J. A. Polson, professor of steam engineering, University of Illinois. Published by John Wiley & Sons, 440 Fourth Ave., New York City; 1931. Cloth, 6x9 in.; 469 pages; numerous illustrations. Price, $5.*

BOOKS, like other commodities, should be evaluated on the basis of the demand for them. No matter how much excellent material be incorporated in the manuscript, there is little justification for issuing it in book form if it does not cover new fields, or shed light on old problems.

The reviewer may be in error, but he has a feeling that the subject of internal-combustion engines has been treated in enough new text books. There are available at present possibly half a dozen middling or fair-to-middling volumes, if cotton-grading terms be permitted. This plethora reduces the possible sale of each volume for, after all, the number of engineering students are limited, one's impressions on the night after a football victory notwithstanding. Authors must be merchandisers and a limited sale of a book means a limited amount of care in the preparation. If publishers would choose one good manuscript on a subject and promote this for three or four years, the net result would be better books for the engineer—no one whose duty entails the pursual of many engineering treatises can fail to be struck with the absence of personality in such volumes.

The volume under review ranks with the best of present-day text books, and contains material upon variable specific heat heretofore ignored by text-book writers. It should find a welcome in those colleges where the faculty feels that a change in text book is desirable, for the treatment is a little better than is found in the majority of recent volumes.

Coal Buyers' Directory

KEYSTONE COAL BUYERS CATALOG AND DIRECTORY 1931. *Published by the McGraw-Hill Catalog & Directory Company, 475 Tenth Ave., New York City; 1931. Leatherette, 8½x11¼ in.; 854 pages; illustrations, charts and tables. Price, $15.*

THIS EDITION of the "national authority on coal buying" has been revised throughout. Additional information in the directory section includes the names, titles and addresses of the vice-presidents in charge of operations at the various coal mining companies, the general managers, general superintendents, mining engineers, electrical engineers, purchasing agents and store buyers; at the individual mines the name of the mine superintendent, mine electrician, etc., are also given.

As heretofore in the mine directory, the names of the president, sales manager or sales agent with their addresses are listed for each coal mining company, together with shipping information, type of mine, number of employees, daily capacity and detailed information on preparation equipment. The book also contains authoritative articles on the rank, usage, analysis and preparation of coals.

With the revised and extended content, this edition of the coal buyers' "Blue Book" should prove an invaluable aid to all coal purchasers and handlers.

What About Russia?

SOVIET FOREIGN TRADE: MENACE OR PROMISE. *By J. M. Budish and Samuel S. Shipman. Published by Horace Liveright, Inc., 61 West 48th St., New York; 1931. Cloth, 5x8 in.; 276 pages, 51 tables. Price, $2.50.*

WHY RECOGNIZE RUSSIA? *By Louis Fischer. Published by Jonathan Cape and Harrison Smith, 139 East 46th St., New York City; 1931. Cloth, 5x8 in.; 298 pages. Price, $2.*

WITH the rapid economic development of Soviet Russia and its increasing importance as a factor in international trade, many questions are being raised in this country as to just what effect this will have on our business and what policy we should purse toward the new Union.

Through a detailed analysis of the character and trend of Soviet foreign trade and the part it plays in the national economy of this country, the first of these books, "Soviet Foreign Trade," attempts to show that Russian business offers a promise of greater prosperity, rather than a menace, to our industries. It points out that the development of Soviet industry, agriculture and transportation will make the Union one of the world's greatest purchasers of the industrial products, particularly machinery and equipment, of which the United States is the leading producer. With extraneous issues eliminated, the authors of this book believe that Soviet-American trade should develop far beyond the present point and result in increased prosperity for both countries.

The second book, "Why Recognize Russia?" takes up the question of our diplomatic policy toward the Soviet Union. It describes in detail the actual diplomatic relations that have existed between the American and Soviet governments and presents fully the arguments for and against official recognition of Russia. While the author makes no plea for recognition, he believes that "the absence of relations between the two greatest countries in the world cannot endure to eternity." The greater the delay in entering into relations with the Soviet government, the more embarrassing the step will be when we do take it, he says.

Both books point out the fact that the success of the Soviet Union's five-year plan of economic development is now practically assured, and that this plan is only the beginning of a series of expansion movements which will undoubtedly increase the importance of Russia as a factor in both the import and export trade of this country.

BOOKSHELF

Standard German Handbook

"HÜTTE." DES INGENIEURS TASCHENBUCH. *Volume I, 26th edition. Published by William Ernst & Sohn, Wilhelmstrasse 90, Berlin W.8, Germany; 1931. Cloth, 5x7 in.; 1,199 pages, charts and tables. Price, 17.50 RM.*

FOR 75 YEARS "Hütte" handbooks have been standard sources of technical information for scientists and engineers not only of Germany but of most of the civilized world. Long before the engineering profession attained wide recognition, these data books were being issued, and it is not an exaggeration to say that they have played, and continue to play, an important part in the collation and dissemination of technical knowledge.

The present book is the 26th edition of Volume I of the series, which covers all phases of science and engineering. This particular volume is devoted to fundamental data and formulas in mathematics, physics, chemistry, heat, mechanics, structures, precision measurements and geodetic surveying. It has been fully revised and brought up to date and contains much tabulated information of practical value to the engineer.

Heating and Ventilation

HEATING AND VENTILATION. *Third edition. By the late John R. Allen and James H. Walker, superintendent of central heating, Detroit Edison Company, with a chapter on hot-water heating systems by F. E. Giesecke, director of the Enginering Experiment Station, Agricultural and Mechanical College of Texas. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 6x9 in.; 426 poges, 261 illustrations. Price $4.*

HEATING and ventilating practice and knowledge has advanced so rapidly since the second edition of this book in 1922 that this edition, though tardy, will be welcomed as a text in engineering schools as well as by engineers interested in this field. The second edition has been gone over thoroughly and completely revised so that it now truly depicts modern engineering practice in both the heating and ventilating fields.

An outstanding addition to the book is the name of F. E. Giesecke as coauthor. Professor Giesecke's research work on hot-water heating systems is well known in heating circles and makes him eminently qualified to write on this subject. The chapter which he has prepared on this method of heating is easily understood and accompanied by convenient charts.

Chapters have been added on unit heaters, artificial cooling of buildings and industrial air conditioning. Other chapters are replete with new and up-to-date information. Included are helpful suggestions on the selection of boiler capacity. In this connection the authors have avoided the controversy existing between the American Society of Heating and Ventilating Engineers, and the Steel Heating Boiler Institute by presenting the methods recommended by both organizations.

Wiring Practice

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER. *37th edition. By H. C. Cushing, Jr. Published by H. C. Cushing Jr., 341 Madison Ave., New York City, 1931. Leatherette, 4x6½ in.; 504 pages, 225 illustrations, tables. Price, $3.*

EACH YEAR, for the past 36 years, a new edition of this valuable handbook has been published to cover the latest wiring practice adopted under the National Electric Code of the National Fire Protection Association. The text contains full information, with illustrations and tables, on standard practice for inside and outside wiring used in electric light and power systems.

In the 37th edition new sections have been added on pole-line construction for light, power, telephone and telegraph lines; house and garage wiring; moving picture theater wiring; and radio wiring. The book contains many tables and other information essential to those engaged in electric wiring work, and the material is presented in a form that makes it of use to the practical man.

BRIEF REVIEWS

RULES AND REGULATIONS GOVERNING DETAILS OF FUEL BURNING EQUIPMENT. Issued by the Department of Smoke Regulation of Hudson County, Court House, Jersey City, N. J.; 12 pages.—In condensed form this booklet contains recommendations for firing power and heating boilers, warm-air furnaces and miscellaneous fuel-burning equipment to reduce the smoke nuisance to a minimum.

TABLES OF DATA ON CORROSION-RESISTING AND HEAT-RESISTING ALLOYS. Compiled and published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.; 11 large tables in special binder; price, $1.50.—Prepared by a committee of the A.S.T.M., these tables contain concise, up-to-date data on the fabricating, mechanical, physical and chemical properties of all of the commercially available metallic alloys used in the design of equipment for modern processes.

A LIST OF ALLOYS WITH PHYSICAL PROPERTIES OF TYPICAL ALLOYS. By William Campbell. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.; 65 pages; price, $1.50.—This is a revised and amplified edition of the list prepared by Mr. Campbell in 1922. The compositions of more than 2,500 non-ferrous alloys are given, together with the physical properties of typical ones.

WISCONSIN VOCATIONAL PAMPHLETS —ELECTRICITY UNIT—PART II. By H. C. Thayer and V. E. Anderson. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 19 illustrated sheets; price, 35c. —One of a series of pamphlets developed by the Vocational Schools of Wisconsin, dealing with the installation of flexible and rigid conduit, armored cable, and metal moulding used in wiring.

TESTS OF A MIKADO-TYPE LOCOMOTIVE EQUIPPED WITH NICHOLSON THERMIC SYPHONS. By Edward C. Schmidt, Everett G. Young and Herman J. Schrader. Published as Bulletin No. 220 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.; 102 pages, illustrated; price, 55c.—This bulletin gives the results of 24 tests of a Mikado-type freight locomotive running on the Illinois Central Railroad, which was operated first without thermic syphons and again after they were installed. It is the first published record of such tests made where operating conditions could be rigidly controlled at the locomotive plant.

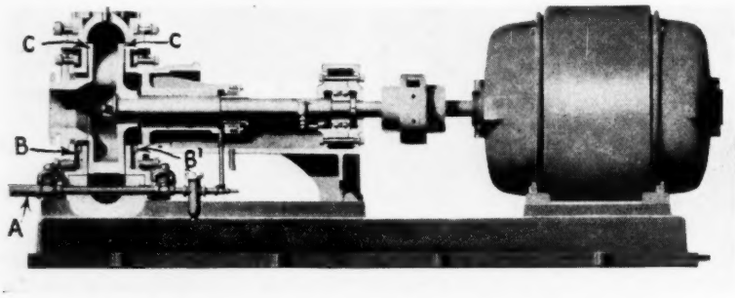
AN INVESTIGATION OF THE MANUFACTURE OF WATER GAS WITH ESPECIAL REFERENCE TO THE DECOMPOSITION OF STEAM. By Lloyd Logan. Published by the Department of Gas Engineering, Johns Hopkins University, Baltimore, Md.; 105 pages; illustrations, charts, and tables.—A detailed technical and economic study of the water-gas process, with full treatment of the air-blasting and steam-blasting periods. A complete bibliography of literature on the subject is included in the study.

WHAT'S NEW IN PLANT EQUIPMENT

Centrifugal Pump For Handling Abrasive-Laden Liquids Employs Hydro Sealing on Impeller

THE USUAL difficulties attending the handling of ash-laden water with a centrifugal pump, that of high maintenance, low average efficiency and discharge-pressure limitations, would appear to be overcome in the hydro-seal centrifugal pump now being put out by the Allen-Sherman-Hoff Company, 219 South 15th St., Philadelphia, Pa.

In this pump, which is designed especially for handling abrasive material laden liquids, the running clearances are sealed with clear water at a higher pressure than the discharge pressure in the main volute. By passing clear water through these clearance spaces, ash and abrasive particles are excluded and the clearances can be maintained at a minimum.

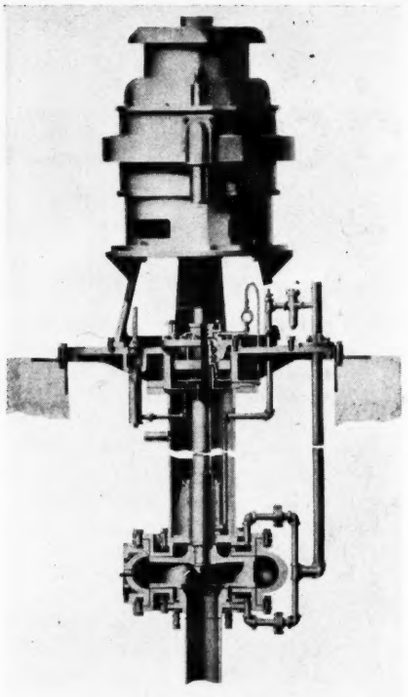


Horizontal type "Hydroseal" pump for handling ashes and other abrasive-laden liquids

In the operation of the pump, which, with the exception of the sealing feature, is identical to that of a standard centrifugal pump, clear water at comparatively low pressure is connected to header *A* and passes into chambers *B* and *B'* on both sides of the impeller. Owing to the adhesion of this water to the side surfaces of the impeller and because of the close clearances (0.006-0.008 in.) at the points *C* the initial pressure of the clear water is boosted above the pressure on the main volute. Thus the annular clearances at the periphery of the impeller are continuously filled with clear water flowing into the volute, and this flow tends to keep these spaces clear of abrasive particles. Another important advantage of the hydro method of sealing the impeller is that only one sealing ring is necessary. This ring is located at the eye in the suction side of the impeller. It is made of bronze and is self adjusting, being held close to the impeller by a resilient packing.

As will be seen from the illustration, a long bearing is provided adjacent to the impeller in both the vertical and horizontal pumps. The shaft is chromium plated at the bearing and water lubrication is used, the bearing being fluted spirally to insure effective flushing and lubrication of the rubbing surfaces. The thrust bearing on each pump is of the double-row angular-contact ball type. In the vertical unit this bearing is inclosed in an independent housing to facilitate adjustment of the impeller to the proper clearance.

A steel alloy of chrome molybdenum and nickel is used for the pump casing and impeller. The volute is of the solid non-split type and of heavy construction, while the impeller is of the totally inclosed overhung type with passages designed to permit free flow of material of a maximum size. A shaft forged of high-carbon steel and of liberal diameter is used.



Vertical type pump with adjustable thrust bearing

To preclude the possibility of the pump being operated without clear water flowing to the impeller's seals and bearings, a pressure cut-out switch is furnished for installation in the clear water service. With this protective device connected in the motor current, should the clear water supply drop or fail or should the filter become clogged, the switch will open the motor circuit and stop the pump.

Although designed primarily for handling ashes, the pump is equally well suited to handling of sand, gravel, coal sludge and other abrasive-like liquids.

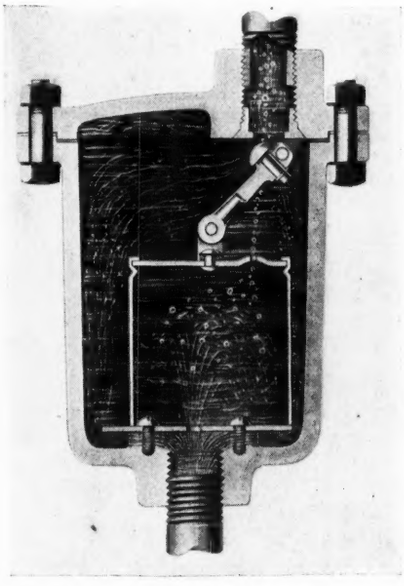
New Inverted-Bucket Steam Traps

SIMPLICITY characterizes the new "Silvertop" Model A steam trap of the inverted-bucket self-venting type developed recently by the V. D. Anderson Company, 1935 West 96th St., Cleveland, Ohio. The trap is being put out in sizes from ½- to 2-in. pipe connections and to operate at all pressures from vacuum to 300 pounds.

Referring to the illustration, the valve is mounted directly on the float lever, thus eliminating compound levers and valve stems. Another feature

of the trap is the use of a deflector at the inlet. This plate, in addition to forming a rest for the inverted float, has an orifice in the center which prevents an excess of inflowing condensate from impinging upon the bottom of the bucket, causing it to rise and partly close the valve. As indicated in the illustration, the excess condensate is deflected toward the trap body and passed upward on the outside of the bucket.

Valve and seat are of nitralloy and all the mechanism, including the lever and pins, is made of heat-treated rust-resisting alloy. The cover gasket is fitted into a recess, precluding the possibility of a gasket blowout. The



Anderson "Silvertop" steam trap

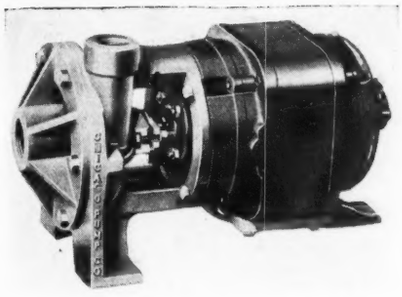
trap is comparatively light in weight and can be carried by the connecting pipe lines without the use of other support.

Close-Coupled Centrifugal Pumps

A LINE of close-coupled horizontal centrifugal pumps (Type N) suitable for hot- and cold-water circulation, brine circulation, pressure boosting and various other industrial services is now being put out by the Chicago Pump Company, 2336 Wolfam St., Chicago, Ill.

A feature of the pump is the three-point suspension used, with two of the three feet under the pump. The pump casing is semi-steel, the shaft stainless steel and the impeller bronze.

Units are available without a water seal for use where there is a positive pressure on the suction, with an in-



Centrifugal pump with three-point suspension

side-connected water seal where there is a vacuum on the stuffing box, and with an outside-connected water seal for use where the liquid being handled is gritty. Capacities available range from 3 to 60 gal. per minute.

Automatic Starter and Flexible Coupling

REDUCTION of starting loads and absorption of shocks and vibration characterize the Rawson automatic starter and flexible coupling brought out by the Washburn shops of Worcester Polytechnic Institute, Worcester, Mass.

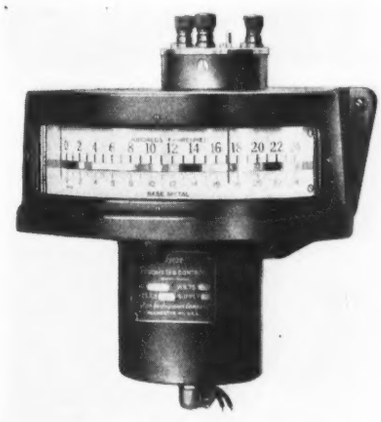
The unit consists of two cast-iron members, one attached to the driving shaft and the other to the driven shaft. Between the two members are inserted floating segments made of brake lining reinforced with lead, a sufficient amount of lead being used to give the required pressure on the friction surfaces for carrying the load.

Upon application of power to the driving shaft, centrifugal force causes the outer or starting set of linings *A* to press outward against the driven member. There is sufficient lag, however, to allow the driving member to attain practically full speed before the centrifugal pressure takes effect.

To give overload capacity and reduce the time required to accelerate the driven unit, where the load is equal to the rated capacity of the motor, a second set of centrifugal friction linings *B* is introduced on the driven side. These linings come into action as the driven member approaches full speed, and provide an auxiliary source of driving that can be made any amount desired, varying with the type of load and the overload requirements.

The starter is designed so that the outside or starting frictional lining *A* can never exert a greater capacity than the rated motor horsepower. It will operate in either a horizontal or vertical position or in either direction of rotation, and can be arranged for direct connection as shown, or for gear, chain, V-belt or flat-belt drives.

Sizes range from 3 to 300 hp., suitable for speeds from 495 to 1,760 revolutions per minute.

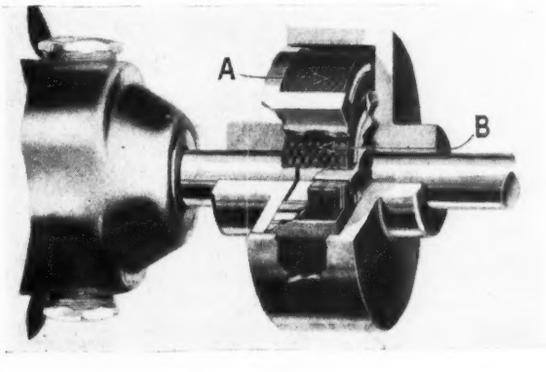


Tycos indicating pyrometer control

Improved Indicating Pyrometer Control

IN THE REDESIGNED indicating pyrometer control recently announced by Taylor Instrument Companies, Rochester, N. Y., a number of new features and improvements have been incorporated.

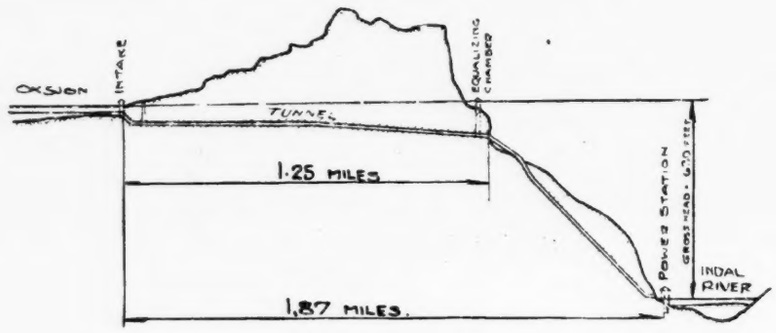
The weight of the instrument has been decreased by 3 lb. and the new model is said to be unusually quick in operation. The back panel has been eliminated and this simplifies wiring and makes the instrument easier to install or take down. A general view of the new model is shown in the accompanying illustration.



Rawson automatic starter and flexible coupling for speeds from 495 to 1,760 r.p.m.

NEWS of the FIELD

Work Started on First Scandinavian Pump-Storage Plant at Sillre in Sweden



Sketch showing general arrangement of Sillre pump-storage plant

THE ROYAL BOARD of Water Falls, Sweden, has just placed an order for the machinery to be installed at the Sillre power station, a new hydroelectric plant to be built at Sillre on the Indal River, some 40 miles from the East coast. This plant will be unique in that it will be the first in Scandinavia to be built as a pump-storage plant.

The general arrangement of the project is shown in the illustration. The Indal River at the point where it passes Sillre lies 650 ft. below a lake called "Oxsjön," some 1.87 miles to the north of Sillre. This lake is the last of a group of lakes and it is proposed to dam up the outlet and take the water through a tunnel and pipeline to the power station.

Initial installation at the plant will consist of a vertical-type generator mounted on top of and directly connected to a vertical spiral-case francis turbine developing 8,600 hp. on a net head of 590 ft. at a speed of 600 r.p.m. Below the turbine a two-stage centrifugal pump with a capacity of 100 sec.ft. at a lift of 650 ft. will be directly coupled to the shaft. Thus, the three units will all be on the same shaft, one above the other.

Under ordinary conditions the pump will be cut out and the turbine-generator will run in the ordinary manner. When the pump is in service, the turbine will run on "no load," air being let into the draft tube, and the generator will be operated as a motor. Power for pumping will be transmitted from other stations of the Royal Board of Water Falls, which do not run continuously at full load due to the seasonal demands of the industries supplied by these plants.

Ultimately there will be two units with pumps and a smaller turbine-generator without a pump, which will have a capacity of 3,000 or 4,000 hp. All of the units will be complete with governors and pressure regulators, and it is expected that the initial installation will be in service during the latter part of 1932.

Roosevelt Signs Cornaire And Knight Power Bills

GOVERNOR ROOSEVELT, of New York, approved on April 28 the Cornaire bill providing for the creation of a public power authority to develop the water-power resources of the International Rapids section of the St. Lawrence River. The authority is to negotiate with Canada concerning the contemplated project, the cost of which is estimated at $170,000,000 to the state. The development is to be financed through bonds issued by the power authority, which is authorized to enter into contracts with private utilities for the distribution of the power to be generated. As yet Governor Roosevelt has not indicated when he intends to name the trustees of the power authority.

The Governor also signed the Knight bill creating a temporary state commission to act jointly with similar commissions of the states adjoining New York to make a survey of utility companies engaged in interstate transmission of power, to formulate the terms of a treaty between such states and the federal government, and to recommend proposed state and federal legislation necessary to regulate effectively the companies engaged in such interstate transmission of power.

A.S.R.E. to Meet in Kansas City This Week

AIR CONDITIONING, industrial requirements and other new developments in the field of refrigeration are covered in the varied program arranged for the eighteenth Western meeting of the American Society of Refrigerating Enginers, which will be held on May 6 to 8 in Kansas City, Mo., with the K. C. Athletic Club as headquarters. Three technical sessions will be held, interspersed with special entertainment, outdoor sports and inspection trips.

Papers to be presented at the technical sessions include: "Refrigeration in Air Conditioning," Maurice Olchoff; "The Refrigeration Requirements for Oil Refining," Harris Pruitt; "Bakery Refrigeration," A. W. Archer; "Management Control of Large Groups of Ice Plants," A. L. Mullergen; "Design of Refrigerator Evaporators," D. P. Heath; "The Noise Problem in Compressors," C. H. Tanger; "Insulated Cold Rooms Used in Various Industries," H. J. Krampe; "The Chemistry of Water Treatment," Dana Burks, Jr.; "Chemistry in Food Freezing and Storage," J. C. Irwin, Jr.; and "Economics of Carbon Dioxide Solidification," F. W. Rabe.

Unemployment a Topic of A.S.M.E. Hartford Meeting

A ROUND-TABLE DISCUSSION on the stabilization of employment is one of the important features scheduled for the fourth New England meeting of the American Society of Mechanical Engineers, which will be held at the Bond Hotel in Hartford, Conn., on June 1 to 3. The discussion will be led by Howell Cheney of South Manchester, Conn., and will take place at the Monday afternoon session. Other features on the program include sessions on power, fuels, petroleum, design, textiles and machine-shop practice.

Papers to be presented at the power

and fuels sessions are: "Radiant Superheater Developments," M. K. Drewry; "Load-Deflection Relations for Large, Plain and Corrugated Creased Pipe Bends," E. T. Cope and E. Wert; "The Decomposition of Sodium Carbonate in Steam Boilers," R. F. Larson; and "How Coal Market Values Are Related to Steam-Plant Design and Operation," G. B. Gould.

Other papers of interest include "Collapsing Strength of Steel Tubes," T. M. Jasper and J. W. W. Sullivan; "The Strength of Thin Cylindrical Shells Under External Pressure," H. E. Saunders and D. W. Windenburg; "Stresses in Dished Heads of Pressure Vessels," C. O. Rhys; and "Analysis of Stresses in Circular Plates and Rings With Application to Cylinders With Rigidly Attached Flat Heads and Flanges," E. O. Holmberg and Karl Axelson.

Power Ship Jacona Will Move to Portsmouth Soon

THE FLOATING POWER PLANT, Jacona, will soon leave Bucksport, Me., for her new berth at Portsmouth, N. H. She has been leased for a period of years by the Public Service Company, of New Hampshire, according to a recent announcement of the parent company, the Middle West Utilities Company.

During her stay at Bucksport, where she supplied power to a large tidewater paper mill until the Wyman Dam plant was placed in operation, she proved her worth time and again, the announcement says. With a rated capacity of 20,000 kw., she generated over 500,000 kw.-hr. on one record day.

In this connection, it is interesting to note that at a lumber conference in Archangel, Russia, on April 4, it was decided to install 100 tractors in barges and use them as floating power plants to supply the timber camps of northern Russia.

Stevens and Columbia Alumni To Hold Economic Conference

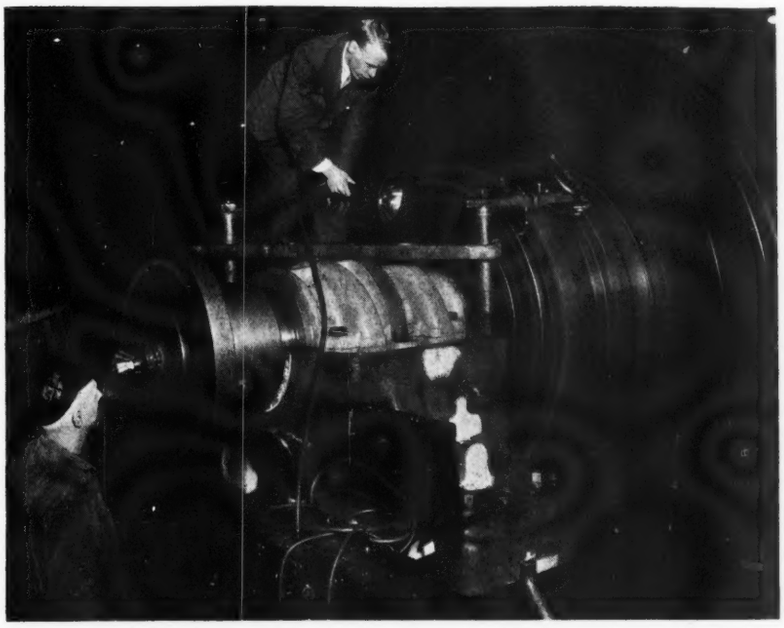
ALUMNI of Stevens Institute of Technology and of the engineering schools of Columbia University have formed an alliance for next summer for the study of economic problems now presented to the engineer, according to plans just announced by President Harvey N. Davis of Stevens for an economic conference to be held in at the Stevens Engineering Camp in New Jersey.

The conference will begin on Aug. 30 and extend through Sept. 7. Alumni of both institutions will spend a week at Camp Stevens devoting several hours each day to seminars, discussions, and lectures on economic problems of world significance and economic topics of more immediate interest to the engineer.

"The engineer," President Davis said, "if he is any good, presently assumes executive responsibilities of some sort, and he instantly finds himself faced by economic problems that too frequently are mysteries to him. He knows his own technique but does not ordinarily know enough about business technique. In our camp session we will try to show what the dollar sign means to the engineer. He must be something of an accountant, and whether his problems are those of financing an engineering project, of management of an industrial plant, of rate making, or of adjustment to seasonal fluctuations or the international cycle of business, they are such problems as require at least an understanding of the philosophy of economics."

The general topic of the lectures and discussions may be suggested by some such phrase as "The Dollar Factor in Engineering," President Davis said. Starting with the special principle of the time factor in money values, the conference will deal with such topics as the economic life of plants and machinery, industrial financing, depletion of natural resources, and the engineer as a tax-payer and an investor.

THE STROBOGLOW APPLIED TO INDUSTRY



AT A RECENT public demonstration industrial engineers of the Westinghouse Electric & Manufacturing Company exhibited the first industrial application of the stroboglow, a portable device which makes rotating objects appear to stand still. The device revealed how much the rim of a large motor rotating at a speed more than 120 miles per hour expanded due to the action of centrifugal force. So accurate was the device that variations in the diameter of the rim as small as one-thousandth of an inch were visible to those witnessing the demonstration.

In the illustration the workman on the left is holding a mechanical oscillator against the shaft of the motor to turn on the stroboglow's light, in the engineer's hand, when certain parts of the motor are in the same position. Since the stroboglow's light is out while the parts are turning around to that same position, the human eye sees them only when the light is on, retaining this image between flashes and thus making the parts appear motionless.

The bulb is a powerful grid-glow tube which is lighted by the heavy oscillatory current discharge of a condenser.

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McIndoes Hydro Station Placed in Operation

NEW ENGLAND POWER ASSOCIATION has placed in operation its McIndoes hydro-electric generating station on the upper Connecticut River. Located seven miles downstream from the Association's 215,000-h.p. Fifteen Mile Falls hydro-electric development completed last fall, the new 16,500-h.p. station is designed to operate as an integral part of that development, effectively utilizing the flow of the river after it has turned the generators at the larger plant and producing a steady flow of water for industries and other hydro-electric plants of the company further downstream.

Construction of the McIndoes development was started in March last year, and the development consists principally of a concrete spillway founded on a ledge extending from the New Hampshire side across the river, with the intake and powerhouse built in as part of it. The new plant increases to 468,770 hp. the installed hydro-electric capacity of the Association.

J. R. Wilde, Chief Engineer Detroit Edison Plants, Dies

JOHN R. WILDE, chief engineer of power plants of the Detroit Edison Company, died on March 29 of bronchial pneumonia at his home in Highland Park, Mich. He was widely known for his pioneer work in the use of pulverized coal for firing boilers.

Mr. Wilde was born in September, 1866. After serving an apprenticeship with the Detroit Shipbuilding Company,

John R. Wilde

he entered the employ of the Edison Illuminating Company in 1889. He was made chief engineer of the company's Willis Avenue station in 1892, and it was there that he first became interested in pulverized-fuel equipment. His work in that field in 1906 was of a distinctly pioneering nature, and it was a source of great satisfaction to him that he lived to see one of the largest power plants in Michigan, that at Trenton Channel, which are equipped with this system of firing.

In 1931 Mr. Wilde was appointed chief engineer of power plants of the Detroit Edison Company. He was a member of the American Society of Mechanical Engineers.

Central Heating Company Formed in Newark, N. J.

FORMATION of the Newark Steam Company as a subsidiary of the Public Service Electric & Gas Company of New Jersey was announced on April 28. Patterned after the New York Steam Corporation, the new company will erect a central steam-heating plant and distribution facilities to supply large office and commercial buildings in the downtown section of Newark. Papers filed with the Secretary of State at Trenton showed that the incorporators of the company are Thomas N. McCarter, president, and Percy S. Young and Edmund W. Wakelee, vice-presidents of the Public Service Corporation of New Jersey.

COMING CONVENTIONS

American Society of Mechanical Engineers. Lubrication meeting at Pennsylvania State College, May 22. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 23-26. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Boiler Manufacturers Association. Annual convention at Skytop Lodge, Skytop, Pa. May 25-27. Secretary, A. C. Baker, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineer. Annual summer convention in Asheville, N. C., June 22-26. District meeting at Lake Tahoe, Calif., Aug. 25-28. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Heating and Ventilating Engineers. Semi-annual meeting at the New Ocean House, Swampscott, Mass., June 22-26. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society of Refrigerating Engineers. Spring meeting at the Athletic Club, Kansas City, Mo., May 6-8. Secretary, David L. Fiske, 37 West 39th St., New York.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Refractories Institute. Annual spring meeting at The Greenbrier, White Sulphur Springs, W. Va., May 25-26. Secretary, Dorothy A. Texter, Oliver Building, Pittsburgh, Pa.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

1931 Midwest Bituminous Coal Conference. To be held at the University of Illinois, Urbana, Ill., May 21-22. Chairman of Program Committee, B. R. Gebhart, Illinois Coal Bureau, 307 North Michigan Ave., Chicago, Ill.

National Association of Power Engineers. Annual convention and mechanical exposition in the Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago.

National Association of Heating and Piping Contractors. Annual convention in Louisville, Ky., May 6-9. Chairman of convention committee, M. J. Chagnard, 419 West Jefferson St., Louisville, Ky.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Sherman Hotel, Chicago, Ill., Aug. 4-8. Secretary of Convention Committee, James J. Blaine, 7342 Harvard Ave., Chicago, Ill.

Personals

IRVING E. MOULTROP, chief engineer of the Edison Electric Illuminating Company of Boston, has been staying in Atlantic City, N. J., convalescing from the effects of a major operation he underwent some weeks ago. His many friends will be glad to know that he is well on the road to good health again.

ROBERT L. HULSIZER, formerly steam engineer of the Luzerne County Gas & Electric Corporation of Kingston, Pa., has become associated with the H. M. Wilson Company, consulting engineers of Philadelphia, Pa.

EDGAR J. KATES, consulting engineer and diesel engine specialist, on May 1 moved his office to 1350 Broadway, New York City.

G. T. SNYDER, chief engineer of the National Tube Company at Lorain, Ohio, has been transferred to the company's engineering department at Pittsburgh, Pa.

Following the election of JAMES F. MCLAUGHLIN, formerly district manager of the Stone & Webster Service Corporation, as president of the Puget Sound Power & Light Company to succeed A. W. LEONARD, who resigned to become chairman of the board, certain changes have been made in the executive personnel of the Puget Sound company. W. H. MCGRATH, formerly vice-president, has been made executive vice-president; L. R. COFFIN, who was manager of the central district in Seattle and King County, has been appointed vice-president in charge of operations; J. F. ALEXANDER, former president of the Houston Electric Company and Galveston-Houston Electric Railway Company, has been chosen to succeed Mr. Coffin as central district manager; WALTER M. BIRD, who was president of the Cape Breton Electric Company of Nova Scotia, has been appointed division manager in charge of the northern, northeastern and eastern districts; and CLAUDE C. CURTIS, formerly vice-president in charge of the Fall River Gas Works Company, has been made manager of the southern, southwestern and western districts.

A. J. GOEDJEN, division manager of the Wisconsin Public Service Corporation at Green Bay, has been elected president of the Wisconsin Utilities Association. Mr. Goedjen has had extensive experience with power companies in the Middle West.

HARRY T. EDGAR, for the past 32 years associated with the Stone & Webster organization in managerial work in various parts of the country, has resigned from the company. Mr. Edgar entered the electric utility field in 1886 as an employee of the Edison Electric Illuminating Company of New Brunswick, N. J., and joined Stone & Webster in 1899.

Business Notes

THE STEEL FOUNDERS' SOCIETY announces the establishment of a development engineering department with headquarters in 932 Graybar Building, New York City, for the purpose of developing new uses and applications for cast steel. This consulting service is offered without bias and at no charge to mechanical engineers, machine and equipment designers, and others responsible for the specification of materials in metal products of all sorts, it is stated.

FORD, BACON & DAVIS CONSTRUCTION CORPORATION has been formed as a wholly owned subsidiary of FORD, BACON & DAVIS, INC., to handle all contract construction activities for the entire organization. The new company will have executive offices at 39 Broadway, New York City, and field offices at Dallas, Texas. Its officers are Edgar G. Hill, president; James F. Towers and William von Phul, Jr., vice-presidents; and Henry F. Storck, secretary and treasurer.

RELIANCE ELECTRIC & ENGINEERING COMPANY, Cleveland, Ohio, announces the advancement of M. C. Suerken to sales representative of its New York office and Robert M. FitzGerald to sales representative of its Philadelphia office.

FRANCE PACKING COMPANY, Tacony, Philadelphia, Pa., has purchased the business of the Martell Packing Company, Elyria, Ohio, and moved it to Tacony. A. H. Krugman, who has been connected with the Martell company for the past twenty years, is now with the France company, it is stated.

SHEPARD-NILES CRANE & HOIST CORPORATION, Philadelphia, Pa., announces the appointment of the Elliott Electric Company, 2178-2186 West 25th St., Cleveland, Ohio, and A. G. Acker, 1409 Keystone Building, Pittsburgh, Pa., as local representatives for the Sprague electric hoists and winches.

THE BORDEN COMPANY, Warren, Ohio, announces that Alfred F. Howe is now Western sales manager of the company, with headquarters at 717 Calmar Ave., Oakland, Calif. Five years ago Mr. Howe was vice-president and general sales manager of the company but resigned at that time to take a vacation in California. In his new position Mr. Howe will take care of the company's business on the Pacific Coast as well as in Nevada and Arizona.

STEAM & COMBUSTION COMPANY announces that it is now operated as a division of the NATIONAL MACHINE WORKS, with headquarters at 1559 Sheffield Ave., Chicago, Ill. The company states that from the beginning of its work the National Machine Works has been associated with it in the development and manufacture of boilers and conversion burners.

How's Business?

THE PERSISTENTLY static condition of business contrasts with continued declines in commodity and security markets. Our index, at 78.8 per cent of normal, still lingers around the levels of the beginning of the year, with slight fluctuations of no significance. The decline in steel activity seems to have slackened slightly this week, but the seasonal drop from March has been a bit sharper than usual, and prices continue to weaken. Building is not holding up well. Carloadings, especially in merchandise and miscellaneous commodities, have made a better showing this week and support other indications of slightly quickened trade activity. But there is still no sign on the horizon of any large-scale action from any source sufficiently strong to offset the certainty of a stagnant summer. National business meetings promise no program.—*The Business Week,* May 6.

Trade Catalogs

FUEL ENGINEERING—In an attractively illustrated booklet, entitled "Where Lies Your Course?" the fuel and power engineering services rendered by the Fuel Engineering Company of New York, 116 East 18th St., New York City, are comprehensively described.

PUMPS AND CONDENSER—New publications of the Worthington Pump & Machinery Corporation, Harrison, N. J., include specification sheet D-423-E8 on vertical triplex single-acting power pumps, W-112-S10 on horizontal duplex piston pattern oil pumps, W-112-S11 on horizontal duplex piston pattern heavy-pressure hot-oil pumps, and W-200-S10 on a patented folded-tube layer-type surface condenser for turbine-generators.

SWITCHBOARDS—The Square D Company, 6060 Rivard St., Detroit, Mich., has just issued a new bulletin, No. CA-508, illustrating and describing dead-front switchboards, with open and enclosed backs.

PRESSURE INDICATION—Bulletin No. 70, recently issued by the Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio, illustrates and describes a power-type pressure device for the operation of a master steam pressure indicating and recording system.

WATER PURIFICATION—Bulletin No. 35 of the Hardinge Company, York, Pa., contains illustrated descriptions of the company's line of sanitation equipment, which includes clarifiers, digestor tank mechanisms, sludge pumps, aerators, coagulation units and Ruggles-Coles dryers.

STEAM TRAPS—Thermostatic steam traps for individual trapping systems are described and illustrated in a new bulletin just issued by the Sarco Company, 183 Madison Ave., New York City.

AUTOMATIC CONTROL—The Brown Instrument Company, Wayne and Roberts Aves., Philadelphia, Pa., has just published a new 48-page illustrated catalog, No. 8008, containing the latest data on automatic controls for temperature, pressure, flow, liquid level and other operating factors in manufacturing processes.

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Fuel Prices

FUEL OIL

Boston—April 27, tank-car lots, f.o.b. 12@14 deg. Baumé, 2.92c. per gal.; 28@32 deg., 4.9c. per gal.

New York—April 30, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

Philadelphia—April 26, No. 3, industrial gas oil, $1.83 per bbl.; No. 4, light industrial fuel oil, $1.31 per bbl.; No. 5, medium industrial fuel oil, $1.20 per bbl.; No. 6, heavy (Bunker C), $1.05 per bbl.

Pittsburgh—April 22, f.o.b. local refinery, fuel oil, 30@34 deg., 2.875c.@3c. per gal.; 36@40 deg., 2.875c.@3c. per gal.

Cincinnati—April 21, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—April 21, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 46.25c. per bbl.; 22@24 deg., 51.25c. per bbl.; 24@26 deg., 52.5c. per bbl.; 26@28 deg., 62.5c. per bbl.; 28@30 deg., 76.25c. per bbl.

St. Louis—April 21, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.245 per bbl., or 42 gal.; 26@28 deg., $1.345 per bbl.; 28@30 deg., $1.47 per bbl.; 30@32 deg., $1.57 per bbl.; 32@36 deg., gas oil, 3.026c. per gal.; 38@40 deg., distillate, 4.026c. per gal.

Dallas—April 25, f.o.b. local refinery 24@26 deg., $1.05 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.70 @$1.90
Pool 10, h. gr. low-vol.	New York	1.60 @ 1.70
Pool 11, low-vol.	New York	1.40 @ 1.50
Smokeless, mine-run	Chicago	1.50 @ 2.00
Smokeless, slack	Chicago	1.25 @ 1.35
Harlan, Ky., slack	Chicago	1.00 @ 1.10
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.50 @ 1.75
Ind. 5th Vein, m.-r.	Chicago	1.20 @ 1.75
Standard Ill., mine-run	St. Louis	1.25 @ 1.40
W. Ky., mine-run	Louisville	.85 @ 1.25
W. Ky., slack	Louisville	.65 @ .85
Pittsburgh, mine-run	Pittsburgh	1.30 @ 1.60
Smokeless, mine-run	Cincinnati	1.65 @ 2.00
Smokeless, slack	Cincinnati	1.10 @ 1.25
Kanawha, mine-run	Cincinnati	1.10 @ 1.35
Kanawha, nut-slack	Cincinnati	.85 @ 1.10
Anthracite (Net Tons)	**At Mine, for Shipment to**	**Price per Ton**
Buckwheat	New York	$3.25 @$4.00
Barley	New York	1.00 @ 1.40

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Pasadena—City plans the construction of a sub-station on Sillen St. Equipment to cost in excess of $50,000.

Calif., San Francisco—Pacific Gas & Electric Co., 245 Market St., will build a sub-station at Broderick and Ellis Sts. Estimated cost $90,000. Work will be done by day labor.

Conn., Bristol—Connecticut Light & Power Co., Leavenworth St., Waterbury, will soon receive bids for the construction of a steam regenerating plant on Riverside Ave. here. Estimated cost $40,000. H. A. Hayden, 175 Main St., Bristol, is engineer.

Conn., New Haven—New Haven Gas Co., 80 Crown St., awarded contract for the construction of a 30 x 45 ft. compressor house at 347 Chapel St., to United Engineers & Constructors Inc., 112 North Broad St., Philadelphia, Pa. Estimated cost including equipment $40,000.

Conn., Waterbury—Dept. of Public Works, plans an election soon to vote $50,000 bonds for waterworks pumping station. R. Cairns, City Hall, is engineer.

Illinois—North American Light & Power Co., C. Studebaker, Jr., Pres., 231 South La Salle St., Chicago, budget for 1931, $15,000,000. Owner has projects in Illinois, Nebraska, Kansas and Oklahoma.

Ill., Chicago—National Realty & Investment Co., 33 North La Salle St., plans the construction of a 38 story apartment building at 1254-40 Lake Shore Drive. Estimated cost $3,000,000. Rebori & Wentworth, 221 North La Salle St., are architects.

Ind., Indianapolis—C. C. Shipp, 230 East Ohio St., will receive bids until May 15 for the construction of hydro-electric plant on Flat Rock River, including dam 23 ft. long, power house, spillway, 20 ft. high and 147 ft. long, turbines, generators and other necessary equipment. Schaeffer & Gift, 208 Castle Hall Bldg., are designing engineers.

Ia., Sioux City—Iowa Public Service Co., c/o W. J. Bertke, Pres., plans the construction of a building to house 13,000 hp. turb-generator, also remodel present power plant on Riverside Ave. Estimated cost $1,300,000.

Ia., Sioux City—C. F. Lytle, 504 Nebraska St., will soon award contract for the construction of an 8 story office building including washed air cooling system and heating system at 5th and Pierce Sts. Estimated cost $750,000. K. E. Westerlind, Badgerow Bldg., is architect.

Kan., Colby—Syms-Shafer Grocery Co., will soon receive bids for the construction of a 2 story, 60 x 265 ft. cold storage plant. Estimated cost $50,000. B. H. Byrnes, 312 National Bank of America Bldg., Salina, is engineer.

Kan., Fredonia—City plans improvements to light plant. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., are engineers.

La., Oakdale—City voted $90,000 bonds for the construction of an electric light and power plant. F. P. Joseph, Glenmora, is engineer.

Me., Portland—Water District, awarded contract for the construction of a booster pumping station to C. W. Cunningham & Son, 181 State St.

Mass., Reading—Dept. of Public Works, will receive bids until May 8 for the construction of a pumping station near Grove St. Estimated cost $50,000. Weston & Sampson, 14 Beacon St., Boston, are engineers.

Mass., Woburn—City is having plans prepared for waterworks extensions including new wells and pumps. Estimated cost $110,000. Metcalf & Eddy, Statler Bldg., Boston, are engineers.

Mass., Wrentham—Dept. of Mental Diseases, plans enlargement of heating plant at State School. Estimated cost $35,000 to $40,000. Engineer not selected.

Mo., St. Charles—City, W. S. O'Neal, Mayor, is having preliminary plans prepared for the construction of a municipal power and light plant and distribution system. Estimated cost $200,000 to $400,000.

Nev., Las Vegas—Dept. of Interior, Bureau of Reclamation, Wilda Bldg., 1441 Welton St., Denver, Colo., awarded contract for twelve booster pumps in connection with Hoover Dam (Boulder dam project) in the upper Black Canyon on the Colorado River,, southeast of Las Vegas to Byron-Jackson Co., 2150 South Slauson Ave., Los Angeles, Calif.

New York—Dept. of Water Supply, Gas & Electricity, Municipal Bldg., plans the construction of a pumping plant at Rondout Creek with additional pumping equipment, pumps, etc. at Croton Lake Gate House. Estimated cost $1,125,000.

New York — Dept. of Water Supply, Gas & Electricity, Municipal Bldg., awarded contract for the construction of pumping plant No. 2 at Croton Lake to Erickson Equipment Co., Grand Central Terminal. $228,400.

N. Y., Brooklyn—Dept. of Hospitals, Municipal Bldg., New York, will soon receive bids for the construction of a power generating plant, boilers, etc. at Clarkson and Albany Aves. here. Estimated cost $800,000. L. P. Ward, 205 East 42nd St., New York, is engineer.

N. Y., Buffalo—University of Buffalo, awarded contract for the construction of a 55 x 108 ft. power house on Main St. to Crooker, Carpenter & Skaer, Crosby Bldg. Estimated cost $250,000.

N. Y., New York—Shire Realty Co., 26 Court St., Brooklyn, plans the construction of a boiler plant and storage building, etc., at 1220 Broadway here. Estimated cost $150,000. Levy & Berger, 375 Fulton St., Brooklyn, are architects.

O., Piqua—City is having plans prepared for the construction of a power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., is engineer.

R. I., Newport—Bureau of Yards & Docks, Navy Dept., Washington, D. C., received lowest bid for the construction of a central heating plant at Naval Training Station from Coleman Construction Co., 86 Weybosset St., Providence. $12,659.

Texas—Central Power & Light Co., c/o Alamo Bank Bldg., San Antonio, acquired electric and ice properties in Aransas Pass, Rockport, Balside, Ingleside and Fulton. Some improvements will be made consisting of enlargement and replacement of machinery. Private plans.

Tex., Brownsville—City, c/o R. B. Renfro, Mayor, voted $150,000 bonds for water and light plant improvements. G. W. Rogers is city engineer.

Tex., Corpus Christi — City, c/o P. G. Lovenskiold, Mayor, will receive bids until May 10 for the reconstruction of La Fruita dam near here as water supply and power project. Estimated cost $400,000. R. J. Cummins is engineer.

Tex., Gladwater—City plans the construction of a complete waterworks and distribution systems including pumping unit, mains, etc. Estimated cost $35,000. Private plans.

Tex., Hillsboro — W. S. Grimes and J. D. Little, Fort Worth, acquired a site and plan the construction of an ice plant on Elm St. here. Estimated cost $40,000 to $50,000.

Utah, Ogden — State is having preliminary plans prepared for the construction of a heating plant at State School for Deaf and Blind. Estimated cost $35,000. E. F. Piers is architect. R. K. Brown, State Bldg. Commission, Salt Lake City, is engineer.

Utah, Salt Lake City—Utah Power & Light Co., G. M. Gadsby, Pres., Kearns Bldg., is having preliminary plans prepared for the construction of first unit of steam power plant on Utah Lake. Initial cost $4,000,000. Total estimated cost $12,000,000. J. A. Hale, c/o owner, is chief engineer.

Wis., Racine—City will receive bids about May 15 for the construction of waterworks pumping station. Estimated cost $500,000. Alvord, Burdick & Howson, 20 North Wacker Dr., are engineers.

B. C., Vancouver — Vancouver Exhibition Authorities, awarded contract for the installation of an electric refrigeration plant in new pure foods building now under construction at Hastings Park to Canadian Refrigeration & Engineering Co. Estimated cost $48,500. Edwards Ice Machine & Supply Co., 3622 East Marginal Way, Seattle, Wash., will supply equipment.

Ont., Toronto—Highland Dairy Co. Ltd., 670 Ontario St., plans the construction of a 35 x 50 ft. cold storage unit. Estimated cost $75,000.

Equipment Wanted

Air Compressors—Chattanooga, Tenn.—U. S. Engineers Office, War Dept., plans to purchase four portable air compressors.

Alternators — Parys, South Africa — Municipality will receive bids until May 30 for supply and erection of 100 kw. or 150 kw. water turbine driven or 150 kw. 170 kw. or 200 kw. oil driven alternators, also distribution system including sub-stations, transformers, meters, motors, etc.

Pump and Motor—Manhattan Beach, Calif.—City, M. J. Crandell, Clk., will receive bids until May 21 for a 600 g.p.m. turbine pump and motor in connection with waterworks.

Pumping Equipment—Beeville, Tex.—Central Power & Light Co., National Bank of Commerce Bldg., San Antonio, plans the installation of new unit of pumping equipment in connection with doubling of water supply. Estimated cost $75,000.

Pumps—Jackson, Mich.—City will soon receive bids for seven deep well pumps for waterworks pumping station, Water St. Estimated cost $81,000.

Pumps—Canton, O.—City plans to purchase eight new deep well pumps to replace old centrifugal lift pumps, etc. Estimated cost $25,000.

Pumps—Youngstown, O.—Mahoning Valley Sanitary District, J. D. Waddell, Pres., will receive bids until May 8 for furnishing and installing five motor driven centrifugal pumps with switching equipment and electric equipment for waterworks plant in Meander Creek Valley water district.

Pumps, etc.—Woburn, Mass.—City will receive bids about May 7 for pumps, etc., for proposed extension to waterworks. Estimated cost $110,000.

Stokers—Shaker Heights, O.—City, J. W. Main, Clk., will receive bids until May 25 for stokers for two boilers.

Turbine—Fontana, Calif.—Fontana Mutual Water Co., P. S. Hasbrouck, Mgr., is receiving bids for a 1,400 g.p.m. deep well turbine, 665 ft. lift.

Industrial Projects

Conn., Ansonia—American Brass Co., Grand and Meadow Sts., Waterbury, awarded contract for addition and alterations to plant on Canal St. here to C. Smith & Sons Inc., 101 Water St., Derby. Estimated cost $100,000.

Del., New Castle—Intercontinental Pipe & Mining Co., c/o H. Kennedy Co., 122 East 42nd St., New York, N. Y., plans altering and re-equipping pipe, steel and iron manufacturing plant here. Estimated cost $1,000,000. Maturity after August 1.

Mo., St. Louis — Busch-Sulzer Bros.-Diesel Engine Co., 3300 South 2nd St., will soon receive bids for the construction of an 80 x 150 and 80 x 90 ft. shop and foundry at 3300 South 2nd St. Estimated cost $250,000. W. J. Knight & Co., 903 Wainwright Bldg., are engineers.

N. J., Elizabeth—Fulton Specialty Co., 128 Fulton St., plans a 5 story addition to rubber stamps factory. Estimated cost $40,000. Architect not announced.

N. J., Jersey City — Mallinckrodt Chemical Works, West Side Ave., awarded contract for a 1 story, 75 x 155 ft. chemical plant to James Mitchell Inc., 24 Journal Sq. Estimated cost $40,000.

N. J., Newark—W. Snyder, 790 Broad St., Archt., is receiving new bids for the construction of a 3 story, 50 x 100 ft. woodworking plant on New York Ave. for J. C. Kohaut Inc., 117 Green St. Estimated cost $40,000. Former bids rejected.

O., Bedford — Lempco Products Co., plans addition to factory for the manufacture of axles and various motor parts. Estimated cost $250,000.

Ore., Portland—S. Birkenwald Mfg. Co., 80 North 5th St., is having plans prepared for the construction of a 1 story, 100 x 100 ft. factory for the manufacture of refrigerators and butchers' supplies at Pettygrove and 22nd Sts. Estimated cost $50,000. R. R. Clark, Railway Exchange Bldg., is architect.

Pa., Pittsburgh — F. Tinker & Sons, 5649 Berlin Way (rolling mill supplies), will soon award contract for the construction of a factory at 5600 Butler St. Estimated cost $40,000. R. M. Reutti, Whitfield Bldg., is architect. Equipment will be required.

N. B., St. John—Canadian Industries Ltd., P. O. Box 1260, Montreal, Que., or c/o E. I. DuPont de Nemours & Co., Wilmington, Del., and 420 Lexington Ave., New York, plans the construction of a fertilizer plant here. Estimated cost to exceed $100,000.